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# The American Surgeon

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# THE AMERICAN SURGEON

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## CHANGES IN THE SURGICAL TREATMENT OF PEPTIC ULCER OVER A TWENTY-FIVE YEAR PERIOD\*

WALTMAN WALTERS, M.D.

*Rochester, Minn.*

Twenty-five years ago most American surgeons were advocating posterior gastroenterostomy in the surgical treatment of peptic ulcer, and a few were advocating pyloroplasty or gastroduodenostomy. The operation, partial gastrectomy for duodenal ulcer, was initiated in the Germanic countries in the nineteen hundred and twenties<sup>14</sup> and used there in preference to gastroenterostomy because gastrojejunal ulceration seldom occurred and no dietary restrictions were necessary after operation. It was slow of acceptance in this country, although Berg and co-workers<sup>2</sup> in 1925, Lewisohn in 1923<sup>13</sup> and later Strauss and associates<sup>23</sup> presented convincing evidence of the advantage of partial gastrectomy over gastroenterostomy in that it reduced the incidence of recurring ulceration to a percentage far below that in their experience following gastroenterostomy. In spite of this evidence, two of the reasons given for not doing partial gastrectomy for duodenal ulcer more frequently were the difficulty of treating a gastrojejunal ulcer which might develop subsequently, and the sacrifice of a large portion of stomach for an ulcer in the duodenum.

The advantages of gastroenterostomy were said at that time to be the low operative risk, although the mortality rate varied from 2 to 10 per cent,<sup>1, 7, 10, 12, 22</sup> and complete relief of symptoms unless a recurring ulcer developed at or near the stoma. The incidence of recurring ulceration after gastroenterostomy was reported by different surgeons as varying from 2 to as high as 15 per cent of cases. This wide variation undoubtedly was due to the fact that follow-up studies were carried out over too short a period and that some of the studies were based on reports from the patients or their physicians whereas others were based on personal ex-

From the Section of Surgery, Mayo Clinic and Mayo Foundation, Rochester, Minn.

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amination of the patients by the surgeons. As Illingworth<sup>11</sup> has said in assessing variations in the results of the treatment of gastroenterostomy reported, particularly in cases in which the patient was not personally examined, "There is a natural tendency on the part of most patients (grateful to the surgeon and also anxious to justify the operation in their own minds) to make light of any subsequent disability." And he continued, "The most satisfactory follow-up investigation is based on personal interviews (a postal questionnaire is quite unreliable) and if possible, at least 75 per cent of the cases should be traced."\*

Among the advocates of pyloroplasty 25 or more years ago were Finney, Judd and Horsley. The value of this procedure, Judd wrote, was its low operative risk and it prevented the possibilities of gastrojejunal ulceration. Unfortunately, however, gastroduodenal ulceration did recur more frequently after it than gastrojejunal ulceration did after gastroenterostomy.

#### PROCEDURES AND RESULTS 25 YEARS AGO

In a symposium on the surgical treatment of peptic ulcer presented before the American Surgical Association in 1930, an attempt was made to secure reports of cases in which 5 years had elapsed from the time of the operation for peptic ulcer. The reports made covered well the status of surgical treatment for peptic ulcer.

Horsley<sup>10</sup> on that occasion reported 11 cases in which pyloroplasty was performed before July 1, 1919; only 3 of the patients were free of symptoms in 1930. He reported that of 84 patients undergoing pyloroplasty only 32 per cent were completely free of symptoms after a passage of 5 years, an additional 14 per cent were regarded as being greatly improved and 37 per cent were unimproved because of recurrence of the ulcer along the suture line. He also reported on a group of 57 patients who had undergone gastroenterostomy. After a lapse of 5 years, 59 per cent were free of symptoms, and 18 per cent were greatly improved. He commented as follows: "Gastroenterostomy has a definite field in the surgical treatment of peptic ulcer, probably the largest field of any operation."

Finney and Hanrahan<sup>7</sup> reported on 627 cases in which operations were performed from 1900 to 1930 for "*chronic ulcer*" with a mortality rate of 8.6 per cent; 62.7 per cent of the patients having gastroenterostomy and 63.2 per cent of those having pyloroplasty were living and well. An additional 20 per cent were improved but 10 per cent having gastroenterostomy and 13.2 per cent having pyloroplasty were not benefited. The mortality rate in cases in which gastroenterostomy was carried out was 8.1 per cent, after pyloroplasty 5.2 per cent, and after partial gastrectomy in the few cases in which it was done, 12.9 per cent.

At the same meeting Judd and Hazeltine<sup>12</sup> presented the results of Judd's method of pyloroplasty; this included excision of the anterior part of the pyloric sphincter. Of 369 patients undergoing this operation between the years 1924 and

\* He reported Clark's material from the Ulcer Clinic in Glasgow to 1951 in which 10 year results after gastroenterostomy were given. Of 206 patients, 119 (57 per cent) were symptom-free; in the disability group 23 per cent had severe disability, 11 per cent had mild disability, and 9 per cent moderate disability.

1928, 90 per cent obtained satisfactory results and 8.1 per cent were not benefited. The hospital mortality rate was 0.43 per cent. Some of the patients were followed only 2 years and others less than 5 years. When these results are considered, it should be remembered that a greater per cent (45 per cent) of patients with duodenal ulcer were operated upon at the Mayo Clinic during that period than in the last decade (14 per cent). Complications of obstruction, of hemorrhage, of perforation and of intractability to medical treatment are at present the indications for surgical treatment of duodenal ulcer.

Balfour<sup>1</sup> at the symposium in 1930 reported on 500 consecutive cases of duodenal ulcer in which gastroenterostomy was performed during 1918 and 1919. Eighty-seven per cent of the patients obtained relief which, it was said, they would not have been able to obtain by any other means; 69 per cent showed complete relief so that no attention had to be paid to diet or habits of living; 13 per cent did not obtain permanent relief. The surgical mortality rate in the group of cases was 1.8 per cent. Nine per cent of the patients had one or more hemorrhages after operation, which are now regarded as the result of recurring inflammation or ulceration; only 1 of these patients died from hemorrhage. Balfour reported recurring ulceration in 4.07 per cent of 491 cases.

Balfour<sup>1</sup> also included data on 100 cases of gastric ulcer in each of which gastroenterostomy was performed during 1918 and 1919. The mortality rate was 3 per cent. In 79 per cent of the 100 cases symptoms were relieved; in 50 per cent they were completely relieved. In 17 per cent results were poor. The late post-operative course was interesting: 1 patient was operated upon later for perforation of the ulcer and 2 for obstruction; 27 had hemorrhages after operation, and 6 later had carcinoma of the stomach. Balfour's conclusion at that time was that increased experience might justify removal of the lesion but that any improvement in results following operation would be more than counterbalanced by the risk of resection.

It must be remembered that these operations were performed in 1918 and 1919, 11 and 12 years prior to the 1930 report.

During the period from 1928 to 1931, Eusterman and Balfour<sup>6</sup> reported that excision of the gastric ulcer with gastroenterostomy was carried out in 26.1 per cent of the operative cases of gastric ulcer and gastric resection was performed in 38 per cent. The risk of operation in 2,244 cases of gastric ulcer in which operation was performed between 1906 and 1927 was as follows: for partial gastrectomy (502 cases) 5.4 per cent; for excision of the ulcer and gastroenterostomy or pyloroplasty (1,202 cases) 3.8 per cent, and for gastroenterostomy (540 cases) 3.9 per cent. In 1935 Eusterman and Balfour reported completely satisfactory results following partial gastrectomy in 90 per cent of cases of gastric ulcer so treated. Removal of the gastric ulcer and gastroenterostomy gave satisfactory or fair results in about 83 per cent of their cases and they cited Walton who had reported that 92 per cent of his patients were well after wedge excision and gastroenterostomy. In discussing causes of postoperative deaths, Eusterman and Balfour stated, "The most common cause of fatality is pulmonary infection and next in frequency is peritonitis."

St. John<sup>22</sup> in reporting a 15.1 per cent mortality rate from gastroenterostomy and 19.6 per cent from partial gastrectomy stated that pulmonary complications were responsible for a distressing percentage of the operative mortality, especially in the gastroenterostomy series.

#### REDUCTION OF OPERATIVE MORTALITY

Reduction of operative mortality did come about with increasing experience and with better understanding of conditions which increased surgical risk and by compensating for them prior to operation. This was accomplished by the administration of adequate fluids, electrolytes, and occasionally blood, by gastric lavage if obstruction was present, and by delaying operation until the patient's disturbed physiologic state had been compensated for as nearly as possible.

Improvements in anesthesia, the development of new anesthetic agents, an understanding of the physiologic aspects which are responsible for the difference between good and poor anesthesia, bronchial aspiration of mucus and other secretions by catheter and bronchoscopy when necessary, led to a marked reduction in the postoperative pulmonary complications. Later the sulfonamides and the antibiotics were used most successfully in combating postoperative pulmonary infections. Indeed, use of the antibiotics in the prevention and treatment of both peritoneal and pulmonary infections has been an important advance in reducing the operative mortality rate in surgical procedures for peptic ulcer. The value of all these factors is reflected in the report of surgery on the stomach and duodenum in 1953<sup>18</sup> from the Mayo Clinic. In that year, 1,029 patients underwent some type of operation on the stomach or duodenum and the operative mortality rate for the entire group was 2.4 per cent. Of the 12 deaths occurring in patients operated upon for peptic ulcer, only 2 were attributed to bronchopneumonia, which probably was a complication of the associated peritonitis. In addition there were 3 deaths from peritonitis.

#### PARTIAL GASTRECTOMY FOR GASTRIC AND DUODENAL ULCERS

As a result of these scientific advancements too it became apparent that partial gastrectomy was the best operation for the chronic or recurring gastric ulcer, for it was followed by practically no recurring ulcerations, the functional results were excellent in most cases, and the mortality rate in the hands of experienced surgeons has decreased progressively: first to less than 5 per cent, and now to less than 3 per cent. In 178 cases in which partial gastrectomy was performed for chronic gastric ulcer at the Mayo Clinic during 1953, it was 1.7 per cent. Partial gastrectomy also removed ulcerating gastric lesions, 20 per cent of which had been reported roentgenographically as gastric ulcer but were found to be malignant.

With increasing experience in gastric resections for gastric ulcer and gastric carcinoma in which there was no difficulty in accurately and easily closing the end of the duodenum, it became apparent that the risk of partial gastrectomy for duodenal ulcer, which had varied from 8 to 18 per cent or more in the hands of some, could be reduced to less than 2 per cent. With improvements in surgical

technic and understanding of the causes of failure of the patient to recover, surgical errors were recognized and compensated for. The surgical errors consisted for the most part in leakage from the duodenal stump. Experience soon showed which duodenal ulcers should be allowed to remain and which could be removed with safety in the process of partial gastrectomy. With the increasing numbers of patients being operated upon, it became apparent that ulceration seldom recurred after adequate partial gastrectomy (approximately  $\frac{2}{3}$  of the stomach removed). In fact, ulcers recurred in fewer than 2 per cent of the patients followed for many years after partial gastrectomy for duodenal ulcer and practically never for gastric ulcer.

The only disadvantages of partial gastrectomy for duodenal ulcer are that many patients have failed to gain in weight and some have the so-called *dumping* syndrome. Fortunately, many patients have preferred not to gain weight and patients who had the *dumping* syndrome found that 6 months or a year after treatment of this condition the symptoms were decreased to a marked extent and usually had almost completely disappeared. Some, however, continue to have it although usually in mild form.

#### VAGOTOMY FOR DUODENAL ULCER

The nutritional state of the patient with an entire stomach naturally should be better than that of the patient with a third of a stomach. Therefore, in the hope of keeping the stomach intact in cases of duodenal ulcer requiring surgical treatment, and to reduce the incidence of gastrojejunal ulcer after gastroenterostomy alone, Dragstedt<sup>5</sup> revived vagotomy which would remove the cephalic phase of formation of gastric acid. He resected the vagi at the lower part of the esophagus which Pieri and Tanferna<sup>17</sup> had done in 1930. This procedure caused healing of most of the duodenal ulcers but not too many of the gastric ulcers. However, gastric stasis resulted and gastroenterostomy or pyloroplasty was added. These added procedures of themselves caused healing of most of the duodenal ulcers\* and complicated accurate determinations of the effect of the vagotomy. Interest in the combined procedure was immediate because it was an easier and, in the hands of some surgeons, a safer procedure. It has been used in more than 2,000 cases since its introduction.<sup>3, 8</sup> The addition of vagotomy seems to reduce the incidence of gastrojejunal ulcer in the first 1 or 2 years following gastroenterostomy, but with the lapse of several years the incidence of recurring ulceration has increased so that it approximates that after gastroenterostomy without vagotomy. In the experience of my colleagues and myself, this reached 5 to 6 per cent in 1951. In addition, from 10 to 14 per cent of our patients had troublesome disturbances of gastrointestinal motility<sup>25</sup> producing fullness after eating, nausea and sometimes vomiting, belching of foul-smelling gas, and diarrhea. These aspects do not mean that there is not a definite place for gastroenterostomy with or without vagotomy, for there is. It especially is useful for the patient with a perforating duodenal ulcer which is too large to remove safely as

\* A properly performed and properly functioning gastroenterostomy will heal all duodenal ulcers unless they are reactivated by a malfunctioning stoma.



part of a gastrectomy or to leave because of the possibility that the duodenum cannot be closed accurately; it also is useful for the elderly patient with an obstructive lesion and low values for gastric acids, and for some middle-aged women whose nutritional state is not too satisfactory. It is useful for this last group because gastrojejunal ulceration tends to occur in women only a tenth as frequently as in men.

#### PROCEDURES FOR GASTROJEJUNAL ULCERS

Twenty-five years ago gastrojejunal ulcers which developed after gastroenterostomy frequently were treated by disconnection of the gastroenteric anastomosis and excision of the gastrojejunal ulcer with restoration of gastrointestinal continuity if the duodenal ulcer had healed and the scar had not obstructed the duodenum. If the scar in the duodenum was obstructive, pyloroplasty was performed. These procedures were carried out by many surgeons. Strauss and associates,<sup>24</sup> however, called attention to the frequency with which duodenal ulcers recurred in such cases. Walters and Priestley showed that duodenal ulcer recurred after restoration of gastroenteric continuity and excision of the ulcer in 50 per cent of cases and recurred in 60 per cent if a pyloroplasty was done. For these reasons and because of the results of the operation, partial gastrectomy at the Mayo Clinic for several years has been considered to be the operation of choice in the treatment of gastrojejunal ulcer developing after gastroenterostomy. The risk of the operation in such cases has diminished with succeeding years and during the past several years the mortality rate has been less than 3 per cent. In fact, operation was performed at the clinic during 1953<sup>18</sup> in 24 cases in which gastrojejunal ulcer developed after gastroenterostomy without any mortality. In 21 of these cases gastric resection was performed. A recent study of end results in cases of gastrojejunal ulcer by Walters, Chance and Berkson<sup>26</sup> showed excellent results in 86.5 per cent of the cases in which partial gastrectomy was performed for gastrojejunal ulcer as against 77.8 per cent when vagotomy was performed.

Twenty-five years ago medical treatment seldom healed a gastrojejunal ulcer for any length of time and gastric re-resection was difficult and risky. In some cases in which the gastrojejunal ulcers were large and perforated, jejunostomy was done in the hope that by putting the stomach at rest by jejunal feedings the recurring gastrojejunal ulcer would heal. I cannot remember a case in which this was accomplished.

Dragstedt's contribution of vagotomy in the treatment of gastrojejunal ulcer after partial gastrectomy has been a great advance. The operative risk is about 1 to 2 per cent. Chance, Berkson and I<sup>26</sup> found that 70 per cent of the patients with gastrojejunal ulceration which had developed after partial gastrectomy had excellent results from vagotomy alone. Such an operation is far superior to re-resection, which is difficult, especially when  $\frac{2}{3}$  of the stomach has been resected previously. The mortality rate is several times greater than that of vagotomy and the results are not as good. Priestley and Gibson<sup>19</sup> reported in May 1948, on a small group of cases in which gastrojejunal ulcer developed after gastric resection. In their cases gastric re-resections were performed without vagotomy with a



mortality rate of 11 per cent and with excellent results in only 50 per cent. In the last few years at the clinic we have performed some re-resections at the time of the vagotomy if an insufficient amount of stomach was removed at the previous resection but the increased risk of the re-resection still is evident.

In 1953,<sup>18</sup> 18 patients were operated upon at the Mayo Clinic for gastrojejunal ulcers which had developed after previous gastric resections. In 13 cases vagotomy alone was performed. Re-resection was done in 4 cases, with vagotomy in 2, and in 1 case in which multiple previous operations including vagotomy had been performed, total gastrectomy was done.

A survey in 1951 of the ulcer problem by the Vagotomy Committee of the American Gastroenterological Association<sup>20</sup> is most interesting. More than 100 surgeons were contacted and reports were gathered from them concerning the relative merits of partial gastrectomy with and without vagotomy and gastroenterostomy with and without vagotomy. This report shows that, with a lapse of from 2 to 3 years after both partial gastrectomy and gastroenterostomy with vagotomy, from 90 to 95 per cent of the patients have had excellent results. The results of gastroenterostomy and vagotomy obtained by my colleagues and myself<sup>26</sup> are not as favorable, for of 141 patients so treated, 70 per cent obtained excellent results; 25 per cent had satisfactory results, and 5 per cent had recurring ulcers. Our mean follow-up period was 2.8 years and that of the American Gastroenterological Association's Vagotomy Committee was 1.6 years. With the passage of time it has been our experience, and that of others, that the results of gastroenterostomy plus vagotomy have worsened because the frequency of gastrojejunal ulceration has increased with each passing year. This incidence was 5 per cent at the time of our study in 1951.<sup>26</sup> On the other hand the incidence of recurring ulcer after adequate partial gastrectomy has consistently remained less than 2 per cent.

#### THE PRESENT SITUATION

I have mentioned the trends in surgical treatment of peptic ulcer over the last 25 years. Now I shall turn to the present and sum it up.

Among the surgeons at the Mayo Clinic the contrasting results in the treatment of duodenal ulcer have led to a progressive increase in the percentage of gastric resections performed each year for the past 9 years and a progressive decrease in the percentage of patients on whom vagotomy is added to gastroenterostomy. Of the 405 patients operated upon for duodenal ulcer in 1953,<sup>18</sup> 348 (85.9 per cent) had partial gastrectomy with a mortality rate of 1.4 per cent; 3 of these had associated vagotomy. Vagotomy with gastroenterostomy was performed on 24 (5.9 per cent) without mortality and gastroenterostomy alone was performed on 25 (6.2 per cent) with a mortality rate of 4 per cent. One patient had a duodenal ulcer excised and gastroduodenostomy and vagotomy performed.

When I say partial gastrectomy, I am referring now almost entirely to the operation designated as Billroth II in which the end of the stomach is sutured to the side of the jejunum after removal of  $\frac{2}{3}$  of the stomach. I shall mention the

newer replacement operations a little later. The Billroth I operation, which consists of anastomosis of the remnant of resected stomach to the duodenum, is an excellent operation for gastric ulcer, and in some cases of gastric carcinoma. In cases of duodenal ulcer, however, the incidence of recurring duodenal ulceration is higher when the Billroth I anastomosis is used after gastric resection than the incidence of gastrojejunal ulceration is when the Billroth II type of gastrojejunal anastomosis is employed. This, I believe, is due to the fact that after gastric resection and Billroth II anastomosis relative achlorhydria occurs in 72 per cent of the cases while after the Billroth I anastomosis relative achlorhydria is achieved in only about 30 per cent of cases. Interestingly enough the incidence of achlorhydria after gastroenterostomy and vagotomy is about the same as that after the Billroth I gastrectomy.

A former president<sup>21</sup> of the American Gastroenterological Association said in the book published in 1951 under the auspices of the association with 77 scientists collaborating: "Partial gastric resection is generally regarded as the procedure of choice in dealing with complicated or intractable peptic ulcers. As Lake has said of the operation, it is the only method of treatment of ulcer which has steadily and consistently increased in popularity. It did not reach this position of eminence by a quick or easy route. . . . Gastric resection supplanted the previously advocated operation of gastro-enterostomy only after a long and at times a bitter controversy." I might add that it did so by reductions in the risk of the procedure by methods mentioned previously and because physiologic and chemical studies showed that with removal of the pylorus and  $\frac{2}{3}$  of the secreting surface of the stomach the hormonal stimulus of gastric secretion is removed and so is obstructive gastropasm. The quantity of gastric secretion and free hydrochloric acid is decreased, and partial neutralization of gastric acidity is obtained by the reflux of pancreatic, biliary and duodenal secretion into the gastric pouch when the Billroth II (Polya) gastrojejunal anastomosis is performed. Gastroenterostomy relieves gastropasm; allows more rapid emptying of the stomach and is followed by some reduction of gastric acidity by reflux of pancreatic, biliary and duodenal secretion through the stoma into the stomach. When vagotomy is added, relaxation and dilatation of the stomach occur and there is a reduction in the quantity of gastric secretion and of hydrochloric acid. This reduction in gastric acidity does not reach the proportions that it does after adequate gastric resection.

The comments to me by a professor of surgery, a student of peptic ulcer for many years, and the author of a recent and excellent textbook on the subject a year ago this summer may be of interest to you. "Gastric resection," he said, "for duodenal ulcer is a great operation—after it, you can eat anything, you can drink anything, and you can do anything. I wish I had had it done ten years ago!"

Before closing I shall call attention to several new technics of gastric resection. They are the tubular gastric resection of Wangensteen, the colonic replacement of the stomach of Moroney and the jejunal replacement of the stomach of Henley.

*Tubular Gastric Resection*

In 1939 Connell<sup>4</sup> suggested fundusectomy as a likely method to reduce acid production by the stomach. He excised a pie-shaped segment from the corpus and fundus, removing approximately 40 per cent of the stomach. Between 1938 and 1940 Wangensteen<sup>27</sup> removed a somewhat larger acid-bearing portion of the stomach by excising the greater curvature. He postulated that tubular gastric resection removes a larger portion of the acid-secreting mucosa of the stomach and experimentally protects the dog against histamine-induced ulcer. The significant portions of his preliminary evaluation in January 1953, of tubular gastric resection on 51 patients follow: Free hydrochloric acid was present in 50 per cent of the cases after operation; hypochromic anemia had not occurred. No abnormal excretion of fat was found in 5 patients, although 80 per cent of the patients had lost weight. Diarrhea was less frequent after tubular resection than after the usual gastric resection which may be, he thought, attributable to the fact that vagus nerves were not interrupted. Recurring ulceration was a possibility in 1 patient. His conclusion was that almost all patients agreed that their health had been immeasurably improved and that results of the operation compare, at an early date, favorably with those of other operations performed in the same hospital for peptic ulcer over the preceding 12 years. In a letter from Wangensteen dated Jan. 31, 1955, he commented that he and his colleagues have done 150 tubular resections for duodenal ulcer and 100 segmental resections. The first tubular resection in the series was done as recently as 3 years ago whereas the number of segmental resections go back more than 5 years and there has not been a single bona fide recurrent ulcer. He stated that both the early and late status of patients (the tubular resections) seem better than that of patients who have had the Billroth II operation, but no physiologic studies of preoperative and post-operative gastric acidity nor fluoroscopic or roentgenographic studies of motility are mentioned.

I have had no experience with this surgical procedure as I have been satisfied with the results which have followed the standard and accepted surgical procedure described in other parts of this paper.

*Colonic Replacement of Stomach*

In 1951<sup>15</sup> Moroney described the use of a segment of a transverse colon to replace the resected portion of the stomach. In this operation, after a segment of transverse colon is isolated and brought up, the distal end is anastomosed to the proximal end of the stomach and the proximal end to the duodenum. This procedure was advised in order to give more capacity to the gastric pouch and in the hope of preventing loss of weight and symptoms of *dumping*. His 1951 report was on 22 patients (20 with peptic ulcer and two with postgastrectomy symptoms). Clinically all patients have complete relief of symptoms and can eat larger meals than those who had the usual partial gastrectomy and the gain in weight has been steady. Fractional analysis after a test meal has revealed

complete achlorhydria, or little acid and excess of mucus. The curves indicating glucose tolerance are normal, and there is no evidence of steatorrhea.

Moroney supplemented this earlier report by another one in 1953<sup>16</sup> in which he stated that he had carried out this procedure on 150 patients for nonmalignant conditions and on 5 after total gastrectomy for carcinoma. There were 107 males and 43 females in his group. The first operation had been performed  $2\frac{1}{2}$  years previously and the interval since operation at time of reporting varied from 6 months to  $2\frac{1}{4}$  years. All except 2 of the patients had been re-examined, and those 2 were examined elsewhere. Of the 22 patients described in the 1951 report, 21 were in entirely satisfactory condition 2 years after the operation but he stated the number was too small for him to come to any conclusion.

In the summary of the results Moroney stated: "The majority of the patients have three or four meals daily and can eat fats and sugar as well as meat. They gain weight, have a good color and are energetic. Some experience epigastric fullness and some 'wind,' but without any other symptoms." Of 100 patients 19 regained their preoperative weight after operation, 62 gained to more than their preoperative weight, and 19 lost weight, and none had postgastrectomy marasmus. One of the most important statements in his report is as follows: "Just as two and a quarter years ago I did not know what a night, a week, a month or a year might bring to these patients, to-day I cannot know what future years may bring."

In a letter from Mr. Moroney dated Jan. 27, 1955, he stated: "For duodenal ulcer I have been unable, I am afraid, to have a complete follow-up just now but I hope to have it completed by the end of the year. This, I think, is evident on over 200 cases, the recurrence rate is about 8 per cent for duodenal ulcer unless a vagotomy is done at the same time. For this reason I am not using it for duodenal ulcer. For postgastrectomy syndromes in over 30 cases the results are very good indeed; there has been gain in weight and freedom, particularly of hypoglycaemia. Again I think that a high gastrectomy, or better a three-fourths gastrectomy with a vagotomy at the time of restoration, is the idea."

#### *Jejunal Replacement*

In September 1953, Henley<sup>9</sup> of London suggested replacing the resected segment of stomach with a segment of jejunum. In his follow-up studies of 73 patients on whom he had used this procedure between Aug. 13, 1951, and Feb. 28, 1953, he stated that *dumping* had not occurred and 97 per cent of the patients had gained an average of 14 pounds. He added, however, that it was too soon to draw any conclusions, and 9 patients were operated upon too recently for any assessment of results. In a letter written on Jan. 15, 1955, he stated that none of the 130 patients undergoing this procedure have had the *dumping* syndrome and 96 per cent have gained an average of 14 pounds. Nine (7 per cent) have developed recurrent ulcers. With the exception of these, "relief of pain and digestion has been complete" and there is no evidence of disturbed motility. He concluded by saying that the period since operation is "between 2 years and  $3\frac{1}{2}$  years"

for 96 and "between 15 months and 2 years" for the remainder. Postoperative studies of gastric acidity were attempted but have not been satisfactory.

The 7 per cent recurrence of ulcer is three times greater after the Henley replacement operation than that following the Billroth II types of gastric resection and slightly greater than that after gastroenterostomy with and without vagotomy in experience at the Mayo Clinic. I suspect, too, that the risk of the replacement operation is higher. It seems to me, therefore, that surgeons should await further developments before considering the use of intestinal replacement at the time of gastric resection for duodenal ulcer. Since the standard types of resection for gastric ulcer have been followed by such excellent results, I can see no advantage in intestinal replacements in such cases.

There may be a definite place for the intestinal replacement in the few cases in which nutritional deficiencies persist but these may be the cases in which ulceration would recur and the pain and possible serious complications of recurrent ulceration would far overshadow the nutritional disturbances.

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## TWENTY-FIVE YEARS' PROGRESS IN DIAGNOSIS AND SURGICAL TREATMENT OF COMMON CHEST CONDITIONS

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At the Second Annual Assembly of The Southeastern Surgical Congress in Atlanta on March 9, 1931, one of the most prominent thoracic surgeons, Dr. Howard Lilienthal, of New York, presented a paper on DIAGNOSIS AND SURGICAL TREATMENT OF COMMON CHEST CONDITIONS. As we all know, Dr. Lilienthal not only was a very skillful surgeon and an astute clinician but was one of the pioneers in the development of this field of surgery in the United States. At that time Dr. Lilienthal made the following statement, which I have taken from his paper published in the Southern Surgeon in July 1932: "Surgery of the thorax has become a specialty and, except in emergencies, operations upon the chest should be undertaken only by those who have had particular training and who have given the subject sufficient thought and study. Indiscriminate operation too often results in death, failure, or the substitution of another condition almost or quite as bad as the original one. Surgeons must learn to appreciate the mechanical and physiologic differences between the chest and the abdomen in their reactions to operative procedure. The selection of method in the free exploration of the chest is a problem for each individual patient instead of being merely a selection of the location for an incision as when laparotomy is performed. The physiologic action of negative pressure in the rigid thorax is very different from that within the mobile walls of the peritoneum. He who wishes to do his best for the patient will either familiarize himself thoroughly with the methods of thoracic surgery or refrain from operating except in an emergency."

Having known Dr. Lilienthal for many years and also having been interested in the development of the surgery of the lung and thoracic contents over the last 25 years, it came as a surprise to note in his paper the brief references to neoplasms, which, at the time of his publication, were not being considered for surgical therapy, and under the heading of TUBERCULOSIS only a brief reference to compression operations such as thoracoplasty to bring about a collapse of the lung. To quote again, "Although most operations for the arrest of pulmonary tuberculosis are performed upon the chest wall and rarely upon the lung itself. . . ." The remainder of the paper is given over to suppurative pneumonitis, abscesses and empyema.

I am sure Dr. Lilienthal, were he alive, would be delighted and amazed to know of the great advances that have been made in thoracic surgery, particularly in the heart, lungs, aorta, and mediastinal structures.

In these eventful 25 years, narcosis and pathologic anatomy have expanded

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the potential field of activity tremendously. The prevention of operative infection could be seen arising on the horizon with unforeseen and unknown success. The fatalistic character was taken away from the success of an operation and for the first time since the existence of surgery the lot of the patient depended to a large degree upon the wisdom, decisiveness, and dexterity of the surgeon who used modern knowledge and method. A partition of responsibility even in a technical sense did not exist. This was in a phase of our specialty which made every surgeon an empirical one and demanded that he explore by his own initiative the unknown field. It is understandable that he had to radiate optimism and kindheartedness as well as authority. The one who had these characteristics, was able to gain the confidence of patients and an equal justice gave him a position in society and the material compensation which we today only know from stories.

The teamwork under which our generation has contributed to progress has lost much of the glitter of previous surgery. This is not possible otherwise with the refinement of the specialties and it would be stupid to try to turn back the wheels of time.

A number of surgeons who today still are active were present in the pioneer days of this specialty. It therefore may be interesting to the growing generation of surgeons and physicians to hear a dissertation of this dramatic event which has prepared the way of progress.

As in all other fields of our specialty, thoracic surgery began with the operative intervention in emergency cases; it was injuries mostly which needed surgical intervention. Even in the beginning of the first World War the basic principle of cautious waiting still was held, and the knowledge that it was sufficient to change the open pneumothorax into a closed one to immediately reverse the danger for life, was accepted only slowly. How insufficient the physiologic understanding of the cause and effect of the intrathoracic changes in pressure were understood can be demonstrated in an example: when among several chest injury patients with open pneumothorax in spite of closure of the chest wall, death due to respiratory insufficiency occurred, there was a definite doubting of the wisdom of active treatment. Today there is no doubt for me, after I can oversee a lifetime of active thoracic surgery, that there was a simultaneous lung injury which was overlooked and which caused, after closure of the chest wall, a deadly tension pneumothorax.

In 1910 the therapeutic pneumothorax of Forlanini had become a common surgical feat of lung tuberculosis, and in 1912 Friedrich had carried out total extrapleural thoracoplasty. Also in 1912, Jacobaeus brought forth thoracoscopic pneumonolysis. Lung resection on patients at that time was in a less happy stage of experimentation. The only intrapulmonary operation which had any kind of success was incision of lung tissue for cleaning out lung abscesses or extraction of bullets.

Surgery of the heart had made no further progress since the glittering feat of Rehn when he sutured a laceration in 1896. The closure of a heart wound remained the aspired aim in the operative repertoire of the surgeon of those days. Much energy was spent to find access to the heart without simultaneously open-

ing the pleural cavity. Weils' operation for constrictive pericarditis was not stabilized then, with less regard to technic than in regard to indication.

In the operative treatment for diseases of the thoracic esophagus, only three successful operations emerged from a large number of failures: Torek's and Zaaijer's resection for carcinoma—in both, immediate reconstruction of the esophagus was not done—and Enderlen's extrapleural esophagotomy was done for extraction of a foreign body. Most of the operative and technical aims of the time concentrated on the main aim of construction of an antethoracic esophagus in stenosis of the mediastinal portion. For many years the work of Kirschner remained unnoticed and unutilized. It appeared in 1920. This showed that to maintain an adequate blood supply to the stomach it was sufficient if only the right sided blood supply—namely, the right gastric artery, the right gastroepiploic artery—remained intact. The left gastric artery, the left gastroepiploic artery and the vasa brevia could be cut easily without danger. With this technic wide mobilization of the stomach could be done; however, it took 20 years to draw practical conclusions from this work.

The surgery of inflammatory and space-occupying tumors of the mediastinum required a good knowledge of the physiologic conditions, but due to infections, offered a poor prognosis. This, however, was due to the false concept that mediastinal focuses, if possible, were to be treated without opening the pleura. The pure mediastinal entrance either by splitting the sternum or by doing a paravertebral resection were inadequate for clear vision.

The fear of opening the pleural space leads us to the rapidly changing story of the pressure differential control in breathing. In the year 1904 Miculicz asked his assistant Sauerbruch to work out a process in which the operative pneumothorax could be circumvented. His aim was to smoothe the path for radical surgery for esophageal carcinoma. He taught, rather falsely as we know today, that carcinoma of the esophagus was relatively benign—more or less comparable to colon carcinoma which metastasizes late and responds fairly well to local excision. Since the time of Vesals, the endotracheal insufflation of the lung was known to experimentators, especially physiologists. The thought of introducing the endotracheal tube via the mouth through the larynx came only five years later (Meltzer and Auer 1909). The decisive reason was in the organization, or better, in the theory of organization of anesthesia. Sauerbruch on principle alone fought the establishment of anesthesia as a specialty. In it he saw a step to the dissolution of surgery as a specialty. His voice in Germany was influential enough to hinder a development from which in other countries thoracic surgery would gain the greatest technical skill and concentration. This has contributed much to attract young physicians to the specialty of anesthesia.

Today it seems difficult to understand the mystery that existed 20 years ago in regard to controlled breathing since this today has become a part of general anesthesia. This had a double drawback. The necessary apparatus seemed so complicated that most of the surgeons could not become acquainted with it. On the other hand, it did not seem possible to carry out even most urgent intrathoracic operations without its help. The dangers, however, of operative pneumo-

thorax have been overemphasized mainly because the basic experiments were carried out on dogs. Here the opening of the mediastinal pleura on one side to the other side almost always leads to a bilateral pneumothorax due to the fine mediastinal wall and this to the inevitable fatal end.

Closely associated with the decrease in mortality rate and morbidity in intrathoracic operations is the maintenance of postoperative negative pressure in the pleural cavity. Here the surgeons became the rather slow students of the pediatrician Bülow from Hamburg, who in the year 1856—long before the physiologic conditions for thoracic surgery had been considered in clinical therapy—treated child empyema cavities with intercostal waterseal drainage. Open thoracotomy at that time, and for many years to come, was the procedure of choice for empyema. Not until 50 years later was the drainage of Bülow, as it was known in Germany, truly recognized, and it is a historic misjudgment to connect the closed treatment of empyema with any other name than his. The latter widely used method has contributed more to the prevention of postoperative complications, such as after resection of lung or esophagus, than improvement of operative technic. In spite of keeping the thoracic cavity closed, this method allows for drainage of blood and wound secretion, a decisive factor in the prevention of pleural infection, and at the same time it allows for quick and complete re-expansion of the remaining lung tissue.

In lung surgery, this fruitful idea of a nonsurgeon, as Bülow, does not stand alone. On the contrary, the initiative and for a long time the practical application of operative treatment for lung diseases as well as in the hands of internists. Forlanini had the idea of therapeutic pneumothorax. Brauer laid down its field of application and a doctor from the Lausanner Clinic, deCervenville, already in the year 1885, advised lung collapse by a circumscribed thoracoplasty and carried out this technic himself. Quincke, Lucius Spengler and again Brauer developed this technic to the ultimate deribbing of the chest wall. Mosler and deCervenville attacked the tuberculous cavity directly and Jacobaeus carried out the endoscopic pneumonolysis to complete the pneumothorax technic. Baer made the suggestion for extrapleural pneumonolysis by filling the achieved cavity with paraffin. The operative opening of lung abscess also was carried out first by the internists Brauer and Kiesling. It is surprising, and certainly not a page of glory for surgery, that its representatives entered this field which had been opened to them by others already rather late and then only cautiously.

Little was added to the indirect attack in the treatment of lung disease. The artificial paralysis of the diaphragm in animal experiments already done in 1905 by Sauerbruch and then introduced in collapse therapy by vonSturz in 1911 gained rapid popularity most likely because of its simplicity, but in actuality was less useful. Today this procedure is disliked with the same fervor. Thoracoplasty was improved by methods of Wilms and Sauerbruch by modifications which entailed a more desired mechanism and a decreased operative mortality rate. Paravertebral resection of the first through tenth ribs today is considered obsolete. With this criticism it often is overlooked that tuberculosis, which was sent to the surgeon 30 years ago, as a rule was fibrocavernous disease involving the

entire lung, making a total collapse necessary, but the poor general condition of the patient did not allow a complete rib resection. Only in the later years when the operative indications for circumscribed upper lobe disease were made, did the so-called apicoplastic procedure of Brauer, with its numerous variations, come into being.

Compression of the lung tissue by fat (Tuffier) or paraffine (Baer) after extrapleural pneumonolysis, was carried out by only a few, until after a suggestion by Meyer in 1915 the extrapleural pneumothorax was suggested by Nissen in 1932. This procedure was popular for about 10 years, a popularity which by far exceeded its rationale. Then its less advantageous sides became more obvious so that the misused method fell into great disrepute. Only now is a very limited field of application gradually emerging. The much derided foreign body or paraffin plombage technic of Baers, which was far better than its reputation, now celebrates a resurrection in the form of lucite balls.

However, one may ask why prolong a discussion over collapse therapy which apparently has disappeared in the therapy of lung tuberculosis? In fact, today excisional therapy has captured the field and, as a matter of fact, to such a degree that in the Anglo-Saxon countries, in Holland and Scandinavia, thoracoplasty, pneumonolysis and pneumothorax have become relatively rare terms.

I would like to give a more measured picture of the field of application of the indirect and direct procedures, but like most all present surgeons who are working on the surgical treatment of lung tuberculosis, I too am an advocate of the present stage of development, which is a radical one, but I am lacking the clear conviction that this path is the best answer in the question of cavity therapy. Making things more difficult is the fact that excision of a focus is occurring more frequently in those patients who, although perhaps with greater length of time, could be treated with purely conservative methods. The very comfortable excuse that the more radical methods have had too little time to have been fully proved or disproved is not possible. The period of observation is adequate, but unemotional evaluation of the distant results needs more cooperation between the surgeon and the internist. On both sides it is clear that there is a lack of necessary objectivity.

The widespread use of lobectomy or pneumonectomy today would not have taken place if streptomycin and the other therapeutic bacteriostatic agents had not been discovered and thus to a large degree extinguished the postoperative complications of tuberculosis. From a practical viewpoint, an important variation of the excision was the segmental resection which rests on the fact that the anatomic unit of the lung is the segment and not the lobe, a fact known for decades.

With the resection of lung tissue a chapter is started which shows the complicated path of surgical improvement in the intrathoracic field. It began under the hopeful auspices of Gluck, one of the most ingenious heads in experimental surgery, who showed in the year 1881 how simply and successfully a lobe of lung—yes, even an entire lung—could be removed in animal experiments. At first, they failed for a long time to find any cases to attempt to do the same on



human beings, in the main part probably because there was no such picture of disease that justified such a radical operation. Malignant tumors, then in a small number, were diagnosed only by auscultation and percussion when they already had passed the inoperable stage, and the physiologic phenomena of bronchiectasis, as can be seen in the groundlaying works of Biermers, could not be diagnosed as to its exact location.

Since very refined methods of bronchus closure failed, the impossibility of a reliable stump closure was accepted. The operative procedure was so modified that an opening of the stump was expected, but its effect was attempted to be minimized. One of such precautions was the use of pleural adhesions between the mediastinal pleura and the lung as well, and between the lung and the thoracic wall. It was a firm law that the obliteration of all pleural spaces had to precede a successful lobectomy. The lung hilus was closed by a tightly fitting rubber tube or by mass ligation. Then one waited until the devascularized lobe spontaneously sloughed off. The open bronchus stump then emptied its contents in a relatively narrow and well delineated cavity. The results of this complicated procedure were not bad. The postoperative mortality rate was between 10 and 15 per cent.

In the year 1929 Harold Brunn published his work on lobectomy with an open intrapleural space. From a practical and historic viewpoint, this work represents a decisive advance which immediately was recognized in the Anglo-Saxon countries. The extraordinary good results that Brunn achieved were not, however, as he believed, due to a particular treatment of the hilus, but because of the added suctional drainage which cared for the removal of air and exudate and therefore secured the re-expansion of the remaining lung.

In the year of 1931, when the problem arose of pneumonectomy on a 12 year old patient with diffuse bronchiectasis of the left lung, Nissen thought it right to use the older more proved method for he had had greater experience with it. The essential problem, however, was not one of technic, but rather functional pathology. One had a few thoughts on this sudden loss of respiratory tissue which followed a total pneumonectomy; the experience from traumatic surgery and collapse therapy had adequately shown that the exclusion of an entire lung could be well tolerated. There was more anxiety as to the future of the empty space which was present after the lung had been removed. Certainly the literature had reported cases of one-sided agenesis of the lung and the authors had pointed out clearly that by shifting of the mediastinum, elevation of the diaphragm and shrinkage of the thoracic wall the problem was solved by nature. The greatest worry, however, came with the closure of the main branch of the pulmonary artery. The observations of lung embolism came clearly to mind and Nissen was fully aware that under these circumstances closure of a main pulmonary branch was associated with a high mortality rate. The successful animal experiments of Gluck and Biondi could not be transposed without changes on human beings, since one knew from experiments on lung embolism that the animal heart, because of its greater reserve strength, can deal better with this problem than the human heart.



Nissen's operation was carried out in July 1931. The hilus was tied off with a rubber tube and several silk ligatures; 14 days later the necrotic lung sloughed off. Photographs taken six years later showed a well developed, healthy appearing woman. Because of the success of the operation many worries were overcome. An embolic-like crisis remained absent after the operative closure of the left pulmonary artery and, in spite of very limited rib resection, the remaining thoracic cavity was overcome by mediastinal shift, elevation of the diaphragm and shrinkage of the thoracic wall.

The second successful pneumonectomy was done in 1933 for bronchiectasis by Cameron Haight in Ann Arbor, Michigan. The technical procedure was the same. The patient today—20 years after the operation—is in good health. She had a child several years after the operation.

Already the third successful operation brought double progress. It was done in one stage by Evarts A. Graham of St. Louis, in April 1933, for a carcinoma of the lung. The patient, a 48 year old physician, today is living, and active in his profession. Graham used Harold Brunn's technic. This operation, however, has the disadvantage that lung tissue must remain behind for closure of the stump, a fact which limits the usefulness of this procedure for the greater number of carcinomas of the main bronchus.

A decisive step in the improvement of the technical procedure was done by us in Baltimore in July 1933, on a  $3\frac{1}{2}$  year old child with fibrosarcoma of the lung. We opened the mediastinum transpleurally; isolated the intramediastinal portion of the right pulmonary artery, the upper and lower pulmonary vein and the main bronchus; ligated the three vessels and could, after successful excision of the lung, close the stump of the main bronchus by individual sutures and secure the suture line with mediastinal pleura. Since the bronchus closure appeared safe, drainage of the pleural cavity was not done. Success proved this procedure to be right. The postoperative course was undisturbed. The child drowned while swimming several years after the operation. Essential changes of this technic have not been made since then and the principles have been carried over for lobectomy and segmental resection.

Once can see that the path taken by lung resection has not been a continuous one. Complete periods of development today appear to us as superfluous and even wrong. Small technical details have as always in surgery had great influence. The time necessary for these details to enter the surgical consciousness and to be carried out seems to be overly long. In addition to this many things occurred because of the influence of factors outside of the surgical field. Thus the frightful increase of malignant bronchial disease has contributed that which radical lung surgery had been deficient of for such a long time—a large number of patients asking for help and an increasing number of physicians and surgeons willing to cooperate.

Perhaps more impressive in its technical development is the progress made in heart surgery. When Rehn in the year 1896 for the first time closed a heart wound with sutures, Sherman noted: "The path to the heart is only 2 to 3 cm. long, but it took surgery 2400 years to take this path". Only a few years previously

Billroth had laid down the sentence: "A surgeon who tries to suture a heart wound should certainly lose the respect of his colleagues", and Stephen Paget, whose book "The Surgery of the Chest" appeared in the year of Rehn's epoch making operation wrote: "No new method or development will make it possible to overcome the natural difficulty which a heart route offers". Only two years later, almost simultaneously, Brentano and Samways suggested the cracking of stenotic mitral valves; and already before Rehn's decisive deed Weil had suggested decortication for constrictive pericarditis with Franck's idea of sympathectomy for agina pectoris in the year 1899; the transthoracic heart massage by Niehans in 1889, Trendelenburg's conception of pulmonary embolectomy followed in 1908. In a period of two decades the basic principles of modern heart surgery had been laid down. They awaited however their practical application for several decades.

Again out of this period of practical inactivity one success stands out, and again we must make the self accusation not to have recognized the importance of this success. This is Souttar's digital cracking of the stenotic mitral valve in a 15 year old girl in 1925. The postoperative course was undisturbed; the patient lived for another five years in good health, then had, without clinical warning, a cerebral embolism probably originating in a clot from the appendage. She died shortly afterwards.

The last decade that saw the consolidation of great and clearly recognized problems of intracardiac surgery, was introduced by three deeds which really represent the pride of this phase of thoracic surgery—the operative treatment of congenital malformations of the heart and its greater vessels. In 1938 Gross reported in Boston the successful tying off of the open ductus arteriosus botalli; in 1945 Crafoord in Stockholm reported the resection of congenital aortic stenosis with an end to end anastomosis, and in the same year Blalock and Taussig reported the creation of an artificial ductus arteriosus for congenital pulmonary stenosis. As always, when surgery has to deal with simple mechanical problems, it can count on success. With open ductus arteriosus and coarctation of the aorta the conditions were fulfilled. Therefore the eventual end results were assured. The Blalock operation was derived from the practical use of shunting of peripheral arterial blood into the deficient pulmonary circulation. This was accomplished by either anastomosing the subclavian artery to the pulmonary artery, preferably on the right side, or the direct anastomosis between the pulmonary artery and the aorta. But since pulmonary stenosis in this case is only a part of the tetralogy of Fallot one can expect from this connection of the major and minor arterial circulations only a palliative effect. However, this palliative effect is adequate to give this procedure a lasting value. Certainly these major contributions did not arrive without certain preparation. In 1910 Monroe already had thought of tying off the open ductus arteriosus. In 1937 Graybiel, Strieder and Boyer attempted to carry out this procedure but without success. At the beginning of the century Carrel already had carried out the technic for arterial suturing which was necessary for the connection of the aortic stumps and the Blalock operation.

The experiences gained when working with the large vessels of the heart have contributed beyond their immediate field of application. In 1924 Kirschner had done successfully the Trendelenburg embolectomy for the first time and, because of the nature of the acute event, he could rely upon the heart with the reserve strength of a healthy patient. Souttar's valvulotomy in 1925, and Sauerbruch's resection of a perforated aneurysm of the heart in 1929 were the first proof of the possibility that the diseased organ as well could undergo surgical attack. The great number of operations done for congenital malformations also doubtlessly have contributed much to encourage operations for valve defects.

What was done under the leadership of Brock, Harken and Bailey again is a glittering page in the history book of thoracic surgery. However, surgery of the heart contains more hope than achievement. Some day it may be possible in a practical useful way to circumvent the blood stream during intracardiac surgery, so that one can see clearly and calmly work in the heart chambers. Or will hypothermia with its decrease of pulse and oxygen demand allow, without damage to the circulation, the exclusion of the organ for a period of time?

The joy of operative achievement remains only for a short period with the last organ which will be considered in its surgical attack. Esophageal resection, the origin of technical development for intrathoracic surgery, finally came to a hopeful beginning 20 years ago when two Japanese surgeons, Oshawa and Seou, separately removed the lowest section of esophagus for carcinoma and bridged the defect with an elevation of the stomach into the thoracic cavity. The operation already had been successful in 13 patients in 1933. The further development utilized the priceless knowledge from the already mentioned experiments of Kirschner's on the mobilization of the stomach. In 1942 Garlock was able to do a similar operation for cancer of the middle esophagus, and in 1949 Brewer, Wylie and Nissen could report the case of a patient in whom a total excision of the thoracic esophagus was done with a cervical esophagogastronomy. Indeed, surgery of the esophagus hardly offers any further great technical problems. Methods of approach, suture securing, and methods of replacement have been systematized. Since Cameron Haight's glittering success in 1944, with an operation for congenital atresia of the esophagus, this terrible malformation as well has come under satisfactory treatment. But the long term results of the most frequent surgical disease—cancer—remain, in spite of all attempts, so bad that the question must be discussed seriously whether on the one hand the surgical attempt and strain, the pain and postoperative difficulties of the patient, are in a rational comparison to the end result, or if it is not better to admit defeat, while it may stimulate experiments for newer radiation therapy.

The description of the tremendous progress that has been made by thoracic surgery in one life span has moved the active surgeon in the foreground. But he who has lived with open eyes in the last period of this stormy development will know that the cause for many of these successes lies only partly on the grounds of surgery. In almost all subjects the operative technical ideas already had been used. Many of them already had been attempted with disappointing results. That our generation was able to make use of these ideas and experiences must be

attributed to those who improved the diagnostic armamentarium and to those who have decreased the operative dangers—the internists and radiologists, the anatomists, the specialists of endoscopy, the cystologists—and to those who have made angiocardiology and catheterization of the heart cavities and vessels clinically possible.

And even of more significance, behind the scenes of the operating room, is the work of those who have shown us the importance of the exact quantitative analysis of water and electrolyte contents, of protein and vitamin metabolism—the men who have taken away the dangers of blood transfusion after decades of serologic research—the anesthesiologists who have made anesthesia an art in use and selection—and finally the scientists and their laboratories in which the antibiotic and bacteriostatic effects of the sulfonamide, penicillin and streptomycin were discovered for the fight against infection.

Almost 60 years ago Stephen Paget wrote in the preface of his well known work on thoracic surgery: "There are signs that we have arrived in this field of our art at a point beyond which we can barely go". But he added: "With caution; with the existing level of surgery". And surgery in those days was almost synonymous with operative technic. However, the progress in this field indeed remained relatively small compared to the tremendous help which has been given our hands by the nonsurgical disciplines. This fruitful influence which is derived from this common ground of general pathology has not yet come to an end. It will remain as long as the medical knowledge in clinic and laboratory continues to progress and as long as young enthusiastic physicians serve this influence. And if one inspects its achievements today, then there certainly is no ground to doubt its continued progress.

## URETEROSIGMOIDOSTOMY: ITS ADVANCES DURING THE PAST TWENTY-FIVE YEARS\*

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The first reported transplantation of the ureter to the intestine in man was that of Smith<sup>19</sup> in 1879—now 75 years ago. In 1881 Gluck and Zeller<sup>10</sup> employed the mucosa to mucosa principle in ureteroenteric anastomosis, a technic revived in recent years by Nesbit<sup>17</sup>, Cordonnier<sup>8</sup>, and others<sup>21, 22</sup>. Chaput's<sup>3</sup> patient who was operated upon in 1892 lived 30 years—probably the earliest of many long survivals following ureterosigmoidostomy. During the past 75 years at least that many technics of ureteroenteric anastomosis have been described including transplantation en masse of the entire trigone with the ureterovesical valve mechanisms intact (Maydl<sup>16</sup>, 1892).

Apparently the first extraperitoneal ureterosigmoidostomy was done in 1892 by Bergenheim<sup>1</sup>, and in 1896 Peters<sup>18</sup> employed catheters inlaid in the transplanted ureter *to avoid uremia*. It is notable that in his presentation to this congress 25 years ago, Dr. Robert C. Coffey<sup>4</sup> confined himself to a detailed description of his technic of ureterosigmoidostomy using inlying ureteral catheters as did Peters in 1896; this operation soon became known as the Coffey II procedure. Yet shortly it fell into disuse. Parenthetically, the Coffey III<sup>5</sup> technic, which followed and is discussed here later, was relatively little used by urologic surgeons.

Doctor Coffey's death was tragic in every way; were he alive today I am sure he would be here to offer some physiologically sound surgical fruit of his lively and resourceful mind. I am honored indeed to be invited to bring up to date the advances—both technical and biochemical—which have been made in ureterosigmoidostomy since Doctor Coffey spoke here 25 years ago.

The immediate success and, by the same token, the long-term success of ureterosigmoidostomy depends upon effective intestinal antisepsis during the operative period together with delicate surgical technic and fine suture material, all of which will do most, not only to promote primary wound healing of the stoma and anastomosis, but to minimize stricture formation. During the past quarter of a century, both the mortality and morbidity rates of uretero-intestinal transplantation have been remarkably decreased by (1) improved anesthesia and surgical technics, (2) greater surgical safeguards such as liberal blood transfusions, maintenance of electrolyte, fluid and blood balance, and (3) the employment of the comparatively potent chemotherapeutic drugs, especially the sulfonamides which were not available generally until 1938, and the antibiotics, which made their appearances in the nineteen hundred and forties.

\* Presented during the Atlanta assembly of the Southeastern Surgical Congress, Atlanta, Georgia, Feb. 21-24, 1955.



## INDICATIONS FOR URETEROSIGMOIDOSTOMY

With the advances noted in the preceding paragraph, the indications for ureterosigmoidostomy have expanded considerably. Today these are chiefly:

## A. In nonmalignant disease.

1. Vesical exstrophy.
2. Complete epispadias in which continence cannot be established.
3. Absence of the urethra.
4. Fistula (such as urethrorectal, urethrovaginal) unsuccessfully treated by plastic surgery.
5. When the shortness of a traumatized ureter prevents ureteroneocystostomy.
6. Advanced vesical contracture due to interstitial cystitis or tuberculous cystitis.
7. Vesicovaginal fistula uncorrectible by other surgical methods.
8. Postirradiation scarring causing urinary incontinence, especially in carcinoma of the uterus.
9. Ureterovaginal fistula.
10. Intractable urethral stricture.
11. Watering-pot perineum (multiple, incurable urethroperineal fistulas with incontinence).

## Indications

- 1 to 4 are employed chiefly in infants and children and indications 5 to 11 are employed chiefly in adults.

## B. Malignant tumors (usually combined with cystectomy).

1. Early infiltrating carcinoma of the bladder with good prospect of cure by cystectomy.
2. Malignancy of the prostate with bladder involvement.
3. Malignancy of the urethra with bladder involvement.
4. Neoplasm involving the lowermost ureter (now often employed palliatively in inoperable malignancy rather than utilizing cutaneous ureterostomy).

## CONTRAINDICATIONS TO URETEROSIGMOIDOSTOMY

These are chiefly:

1. Absence of anosphincteric control.
2. Advanced renal insufficiency.
3. When a hopeless extraurinary tract condition coexists.
4. When there is advanced ureteral dilatation (this condition is a decided contraindication to the Coffey technic, but ureterosigmoidostomy by the mucosa to mucosa anastomosis technic may be employed in many patients with dilated ureters).

## AGE FOR OPERATION

Exstrophy of the bladder is the usual indication for ureterosigmoidostomy in early life and should be done by the time the child is 12 months old; my choice



is between 8 and 12 months of age. When rectal prolapse or other rectal malformation coexists, it should be corrected prior to the ureterosigmoidostomy to establish a good analsphincteric control without which the ureteral transplant is contraindicated. Undue delay in doing ureterosigmoidostomy favors grave injury to the urinary tract, chiefly by infection, although unsuspected congenital ureteral obstruction, especially at the ureterovesical junction, often is present (fig. 1). Without ureterosigmoidostomy about half of these unfortunate children are dead of renal infection by the tenth year. In my experience, as in the experience of many others, these infants withstand the operation well. With proper attention to: (1) preoperative preparation, (2) surgical technic and especially gentleness of tissue handling, (3) postoperative care, (4) preservation of body heat, (5) combat of shock, (6) chemotherapy, and (7) the liberal administration



FIG. 1. Congenital bilateral ureterovesical junction stricture in a girl 8 months old with vesical exstrophy. The resulting dilatation of the ureters generally reduces the prospects of a satisfactory end result in ureterosigmoidostomy. Note absence of pubis. (From Campbell's *Urology*, Vol. 1, W. B. Saunders Company, Philadelphia, 1954).

of antibiotics, these young patients should not be denied the necessary surgery nor should it be unduly delayed. In older persons, the operation is done as soon as its indication is recognized and the patient is properly prepared and surgically fortified for the ordeal.

#### PREPARATION FOR URETEROSIGMOIDOSTOMY

The objective of preoperative preparation is to get the intestinal tract, and especially the large bowel, as empty and as physically clean as possible and, for the operative and immediate postoperative period, as near sterile as possible. A non-residue diet is given for 4 to 6 days preoperative; each morning a saline enema is given until the return is clear and at night another similar enema usually is given. A mild laxative is administered daily before breakfast. Control of the intestinal pathogens is sought by the administration of sulfasuxidine or sulfathalidine 0.25 Gm. per kilogram of body weight in 4 divided doses daily for 1 week, or aureomycin, terramycin, or panmycin, 500 mg., is given every 6 hours for 4 to 6 days.

The morning of the operation a final enema is given until the return is clear and in the operating room a rectal tube of adequate caliber is anchored in situ by a suture to be left for 8 to 10 days.

#### THE OPERATION

*Anesthesia.* When Coffey presented his paper on ureterosigmoidostomy before this congress 25 years ago, spinal was the anesthesia of his choice and still is the preference of many for this procedure. Excellent abdominal relaxation, collapse of the intestines and remarkably good localization are obtained with spinal anesthesia. Yet, the comparatively newer anesthetics such as ethylene and cyclopropane, often with the assistance of intravenous sodium pentothal, are sometimes indicated rather than spinal anesthesia in infirm or elderly patients. In my work, although I have used it in over 2500 patients, I now avoid spinal anesthesia as much as possible. Ether is the usual choice of anesthetic in infants and young children although in several of my young patients sodium pentothal and nitrous oxide-oxygen have been most satisfactory and have spared the patient postoperative ether sickness. The choice of anesthesia will be governed by the ability of the anesthesiologist.

*Surgical Technic. The Coffey I Operation.* This operation was devised by Coffey<sup>6</sup> in 1911 to reproduce as well as surgically possible, the physiologic valve mechanism of the normal ureterovesical junction (figs. 2, 3). The transplanted ureter is run beneath the intestinal mucosa for 1.5 or 2 cm. before it enters the lumen of the bowel and by the intraenteric pressure of gas, fluid, and feces keeping the intramural ureter compressed, it is hoped that rectoureteral reflux of urine, feces, and infection will be prevented. Unfortunately, this objective rarely is entirely achieved.

The Coffey I procedure with or without modification has been employed in more patients than any other technic and often with most satisfactory results. In many instances the apparent early success has been followed 2 to 10 years later by stricturization at the site of implantation of the ureter into the bowel,

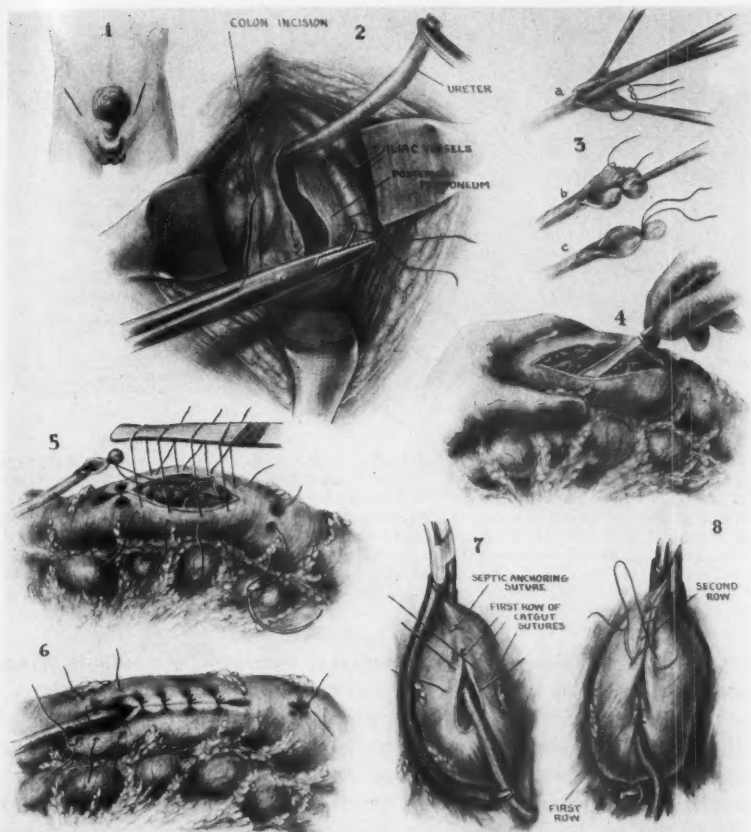


FIG. 2. Ureterosigmoidostomy by Coffey's I technic which, with or without modification, probably has been used more often than any other method. 1. Incisions. 2. On the left is shown the incision over the ureter; on the right the ureter has been detached from the exstrophic bladder, mobilized and closure of the posterior peritoneum has begun. 3. Preparation of the ends of the ureter for reimplantation; a, the end of the ureter is split and a linen or silk thread is passed through half of the duct and tied; b, the thread is now tied around the other half of the duct; c, both ends of sutures are threaded in needles. 4. The peritoneal and muscular coats of the intestine are incised and the mucous membrane is freed from the muscular coat. 5. The first layer of sutures has been placed. A stab wound has been made into the rectal lumen at the distal end of the incision and into which the ureter is being drawn down beneath the intestinal sutures. 6. The ureter has been implanted and anchored by its traction suture inside the intestine; some of the intestinal sutures have been tied. Note the small anchor sutures which fasten the ureter to the peritoneum of the intestine. The tied end of the traction suture is being inverted by a Lembert purse-string suture. 7, 8. C. H. Mayo's modification of the Coffey operation, using rubber-covered intestinal clamps to hold the sigmoid; fine chromic catgut is used instead of fine linen or silk; every other interrupted suture picks up the ureteral wall and a continuous catgut suture covers all the interrupted sutures.

often in the elongated intramural section where the ureter was placed in the bowel to achieve a physiologic valve action. Sometimes the obstruction has been directly at the point of angulated contact of the ureter with the external bowel wall, an observation which too frequently has been overlooked, and a technical

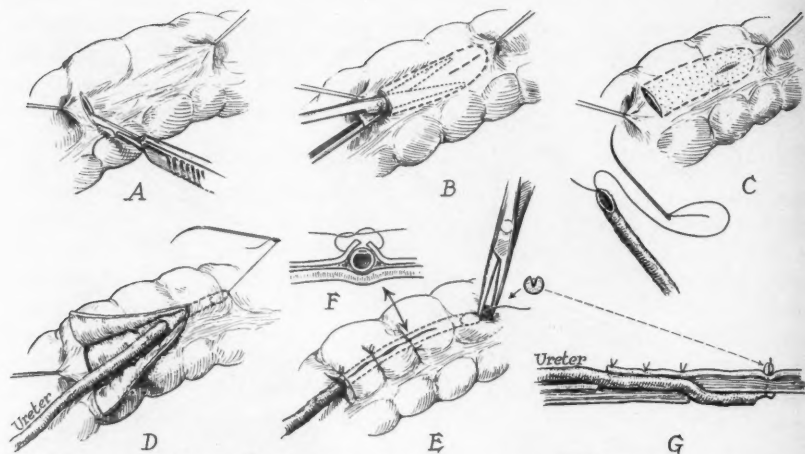
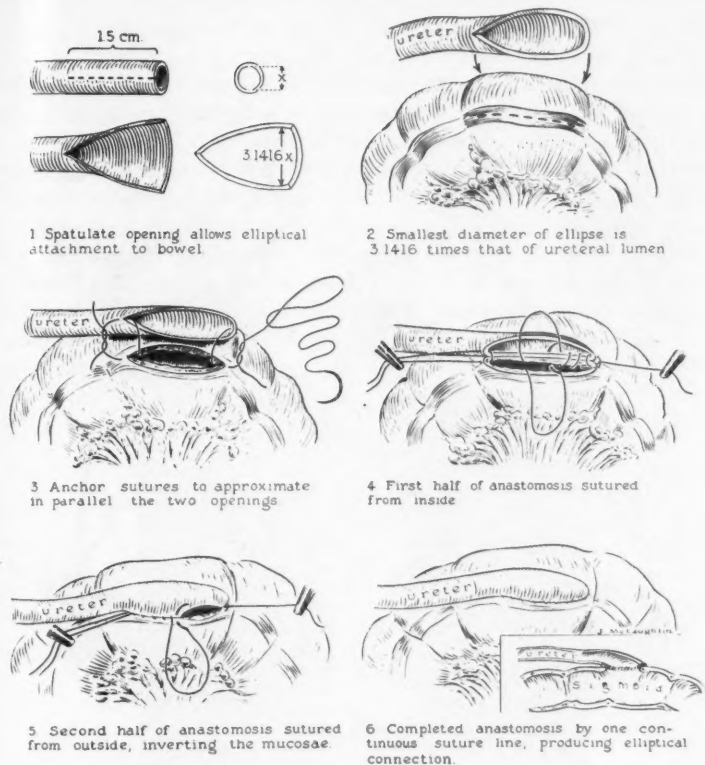


FIG. 3. Campbell's modification of the Coffey procedure in which the ureteral transplant into the bowel is made subperitoneal rather than submucosal with a view to minimizing local sclerosis which so commonly follows extensive separation and dissection trauma coincident to the formation of a submucosal trough for the ureter (A, B, C). A single ureteral anchor suture is employed (D, E, G) which is fastened with a split shot. (F). The suture which closes the bowel serosa over the ureter also passes through the adventitia but not the muscularis of the duct. Following this extremely simple procedure, using only 4 sutures, the postoperative results have been satisfactory, some patients having been observed for more than 10 years after operation.

point with which I always have been seriously concerned. Recently in extensive experimental work, as well as studies predominantly in human beings thus operated upon, Maluf<sup>14</sup> found the constriction to be chiefly at the orifice or meatus of the cut off transplanted ureter. This is most striking in those instances in which the *elephant trunk* type of transplant had been made, viz: the ureter was transplanted to protrude 1.5 to 3 cm. into the lumen of the bowel (e.g., Kerr and Colby<sup>13</sup>; Mathison<sup>15</sup>). Irrespective of the length of the *trunk* and the height of the intraluminal nipple, the stenosis was at the ureteral orifice.

Because of the high frequency of development of ureteral stricturization at the site of implant, technics to minimize this complication have been developed during the past 15 years and chiefly by revival of the mucosa to mucosa type of anastomosis. Just how great these advances are is subjudice, for while the immediate results of these new technics in general have been good insufficient time has elapsed to warrant critical conclusions. In these procedures no attempt has been made to create a valve-type anastomosis but rather a direct elliptical (Nesbit) or end to side (Chaput-Cordonnier) union is made.

The fundamentals of the Nesbit procedure are shown in figure 4, the elliptical anastomosis being made with sutures passing through the ureteral and bowel walls including and uniting the mucosas. In the Cordonnier technic the mucosa of the bowel and of the cut off ureter are sutured at four equidistant points; an outside reinforcing row of sutures then is taken (fig. 5). Woodruff, Cooper and Leadbetter<sup>22</sup> and, independently, Weyrauch and Young<sup>21</sup> extended the



#### Uretero-Sigmoid Anastomosis by Direct Elliptical Connection

FIG. 4. Ureterosigmoidostomy by direct elliptical anastomosis as recommended by Nesbit. (Courtesy Dr. Reed M. Nesbit and the University Hospital Bulletin, University of Michigan Medical School)

Cordonnier technic by adding a short submucosal tunnel to prevent wound leakage or rectoureteral reflux. This technic has produced excellent immediate results in the hands of many.

For protection against ascending intramural spread of infection to the kidneys following these nonvalve-type anastomoses, reliance is placed on the normal downwards peristaltic propulsion of urine by the tonic ureter. The aperistaltic dilated ureter presents a grave problem and ureterostomy counterdrainage must be employed for a sufficiently long time following ureteroenterostomy to enable the ureter to regain satisfactory peristalsis.

One of the newest technics is that of Mathison<sup>15</sup> which was designed to prevent both entero-ureteral reflux and ureteral obstruction (fig. 6). The first stage of the operation is end to side anastomosis with interrupted sutures in the Chaput-Cordonnier manner. This union then is engulfed by a cuff of adjacent



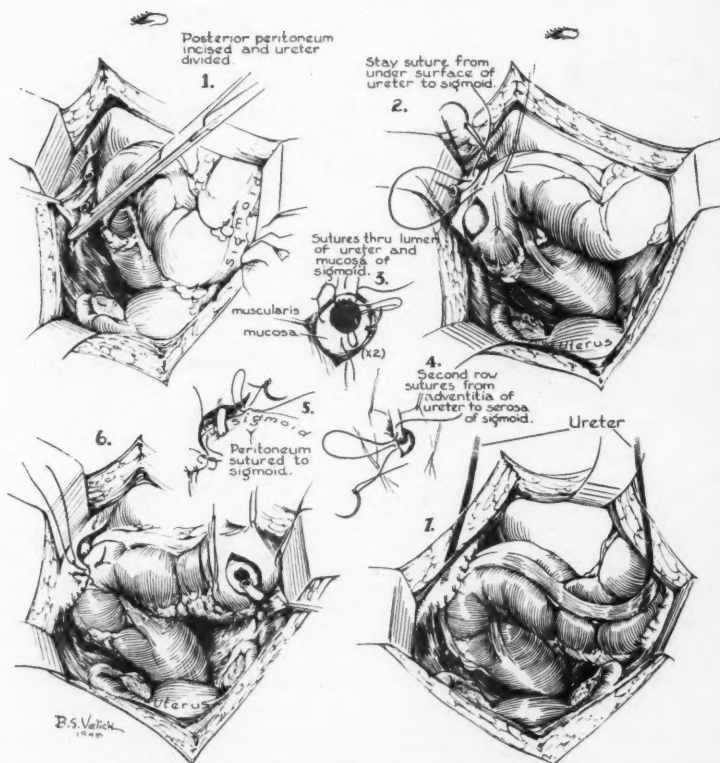


FIG. 5. Ureterosigmoidostomy by Cordonnier's end to side mucosa to mucosa method. (From Cordonnier, J. J., *Courtesy Surg. Gynec. and Obst.*, 88, 1949)

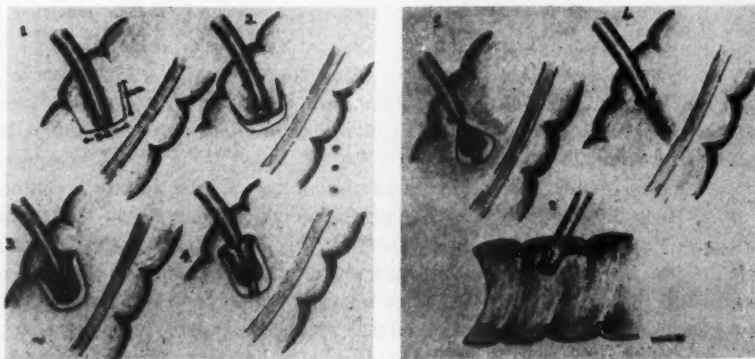


FIG. 6. Ureterosigmoidostomy by Mathison technic employing a cuff of colon wall about the transplanted ureter to make a nipple extending into the bowel lumen, and to afford a variable sphincteric action about the end of the ureter. (From Mathison, W., *Courtesy Surg. Gynec. and Obst.*, 96, 1953.)

colon wall which surrounds the lower end of the ureter to afford a sphincteric action and to produce a nipple-like projection into the bowel lumen. While splendid early results have been obtained with this technic, stenosis of the ureteral meatus has been found in some patients<sup>14</sup>.

In order to reduce the danger of wound leakage at the site of transplant, Coffey<sup>7</sup> first, and later Higgins<sup>11</sup> and Jewett<sup>12</sup>, devised variations of technic for the delayed establishment of the uretero-enteric fistula. In the Higgins and Jewett procedures, both unopened ureters are run beneath the bowel mucosa for a few centimeters to reappear and continue to the bladder, thus maintaining free renal drainage. In the Higgins technic a silk suture is passed to include the rectal mucosa and the full thickness of the ureteral wall where the fistula is desired; the suture is tied tightly to produce cutting necrosis. It cuts through in 3 to 4 days to open the uretero-enteric fistula. In Jewett's technic the distal ureter on

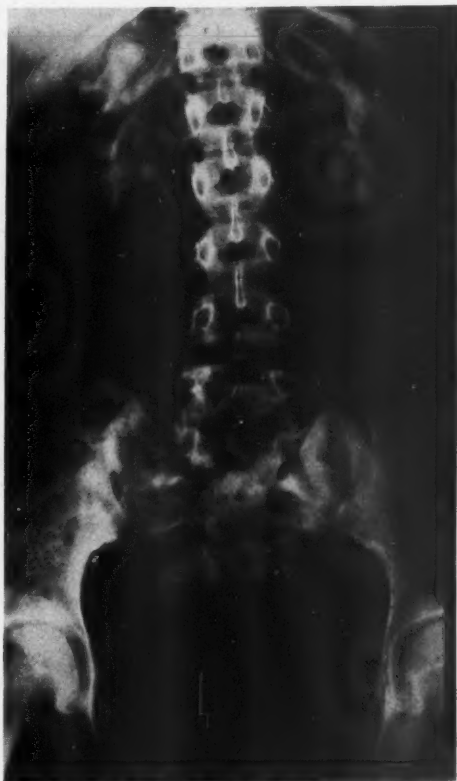


FIG. 7. Excretory urogram 17 years following ureterosigmoidostomy by Higgins's method when the patient was 4 years old. In the interim she gave birth to a healthy child. At the time of operation, her blood Wassermann was 4 plus, but apparently vigorous anti-syphilitic treatment was successful. Note absence of pubis with wide separation of rami. There is mild dilatation of the urinary tract.

each side is divided at a later sitting as it emerges from the new tunnel in the bowel wall and, employing a small special electrocutting electrode passed upwards through the divided stump, the ureteroenteric opening is cut generously into the bowel lumen. Thus in each of these technics the transplanted ureter is not divided until a good ureterorectal fistula has been established. Like the Coffey II and III procedures, the Higgins and Jewett technics seldom are now used by urologists in general. I operated upon a 4 year old girl by Higgins's method in 1933; she now is alive and well 22 years later (fig. 7) and 5 years ago she gave birth to a child.

*Postoperative Care.* A generous fluid intake is maintained for 3 days by intravenous administration including protein hydrolysates. By eliminating fluid intake by mouth for a few days much air swallowing and gaseous distension is avoided. A Levine tube is passed into the stomach immediately postoperative and is connected with the Wangenstein suction apparatus for 3 or 4 days to maintain enteric decompression. When there is no abdominal distension present and auscultation reveals normal intestinal peristalsis, the suction decompression is discontinued.

The rectal tube which was anchored in the rectosigmoid immediately preoperative is connected at once with the drainage bottle; sometimes mild suction is applied. In any event, it is imperative that free dependent drainage from the inlying rectal tube be maintained at all times to prevent intraperitoneal wound leakage at the site of ureteral transplant(s). In short: (1) the rectosigmoid must be kept free of feces and as free of fluid as possible, (2) raising the foot of the bed is prohibited, and (3) the drainage tube must rest under the leg and not over it. As a rule it is safe to remove the rectal tube after 1 week but I generally leave it in for 10 days.

Enteric antisepsis is employed liberally for 10 days postoperative, using those substances acting against gram negative bacilli in particular (e.g., aureomycin, achromycin, terramycin, panmycin).

Beginning on the fourth day a low residue diet is given for 2 days, then a soft diet for 2 days more, with gradual resumption of a normal diet. With the return of food intake by mouth, an ounce of mineral oil is given once or twice daily to maintain semiliquid stools and thereby minimize the likelihood of rectal tube blockage.

*Postoperative Complications.* Aside from: (1) failure of the uretero-enteric opening to drain, (2) the occurrence of acute pyelonephritis, (3) peritonitis consequent to leakage of contaminated urine or of feces at the site of ureteral transplant to the sigmoid, and (4) electrolyte disturbances, the postoperative complications are those which may ensue following laparotomy in general. Of the complications just enumerated numbers 1 and 2 demand prompt nephrostomy and antisepsis; number 3 requires reopening of the wound and establishment of free drainage.

*Electrolyte Disturbances.* During the past 15 years it has become recognized that the acidosis and uremia often seen after ureterosigmoidostomy result not from ureteral obstruction and pyelonephritis as previously believed, but from

absorption of chlorides and urea from the colon (Jewett<sup>12</sup>, Ferris and Odel<sup>3</sup>, Boyce and Vest<sup>2</sup>). This absorption may be prevented by continuous irrigation of the colon with tap water run through the two way rectal tube (Ferris and Odel). It seems likely that the urinary chloride absorbed from the bowel is disposed of by increased ammonia formation and excretion. This ammonia absorbed by the blood from the colon is converted to urea in the liver and this, in turn, explains the high blood urea commonly encountered following ureterosigmoidostomy and despite urographically normal kidneys. Doubtless much chloride excreted into the bowel with the ammonia is reabsorbed to continue a vicious cycle. To combat this grave physiologic disturbance, a low salt intake or even a salt free diet is advocated together with a low protein alkaline-ash diet, not only to decrease urea formation but to offer a base for combining with (neutralizing) the chloride ions (Boyce and Vest). Frequent emptying of the rectum and a large fluid intake also will help to reduce chloride absorption. The treatment of this complication rests upon the administration of electrolytes and fluid in type and quantities indicated by repeated laboratory estimations.

**Mortality.** Three decades ago when the ureters were transplanted at separate operations, the surgical mortality rate ranged from 4 to 10 per cent, but when bilateral simultaneous transplantation was done, the rate rose to 15 to 20 per cent (Walters and Braasch)<sup>20</sup>. Today, and this is real surgical progress, the mortality rate in most clinics is not over 5 per cent in all cases, and in some centers it is not over 3 per cent. In my practice, when the condition of the young patient and surgical facility permit, I employ bilateral uretero-enteric anastomosis at the same sitting through a transverse suprapubic Cherney type of incision.

#### SUMMARY

The most important advances in surgical treatment by ureterosigmoidostomy are improvements in: (1) preoperative preparation and postoperative care of the patient, (2) anesthesia, (3) operative technics, (4) knowledge of electrolyte balance, fluid and blood environments and, of invaluable aid, (5) an entirely new life-saving chemical and antibiotic therapy. The reduced surgical hazard consequent to these advancements has widened extensively the scope of application of ureterosigmoidostomy especially in the treatment of cancer of the bladder by cystectomy in adults, and vesical exstrophy in early infancy.

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## PROBLEMS IN MANAGEMENT OF GASTROINTESTINAL HEMORRHAGE

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To the Members of the Southeastern Surgical Congress:

May I express my appreciation for your kind invitation to participate in this splendid conference.

Second, I want to congratulate you on having received at your last meeting in Birmingham one of the most constructive and inspiring presidential addresses I have read in many years. If you have forgotten that address, I hope you will reread it as it appeared in the July 1954 issue of *The American Surgeon*. Dr. J. R. Young's message should be rebroadcast and widely distributed. His emphasis on the fact that 99.4 per cent of your membership are practicing ethical surgery and rendering a high standard of efficient altruistic service appeals strongly to me as the true and proper note to be stressed by the president of a representative surgical society. So often in the recent past officials of our surgical societies have used their high offices to broadcast the shortcomings of that other .6 per cent, and by so doing have lowered the public's confidence and respect for the 99.4 per cent. My congratulations to Dr. Young and my compliments to you for having chosen as your president a man of his character and courage.

The subject of my presentation today—"Problems in Management of Gastrointestinal Hemorrhage"—was chosen because it has presented a problem and a challenge to me; and it has provided the opportunity for careful detailed study of 60 personal cases.

In perusing the literature and after reviewing reports of 3817 cases of gastrointestinal hemorrhage I found what seemed to be much confusion and difference of opinion as to the best management of these cases. Furthermore I found it extremely difficult to compare results because of the variation in criteria for the selection of cases and the wide differences in the classification of the severity of the hemorrhage. There is, however, beginning to appear in the literature a clearer definition of what constitutes a massive hemorrhage, and a more general agreement as to the selection of patients for operation. Thus there is evidence of a closer relationship and better teamwork between the internist and the surgeon in the management of these cases of gastrointestinal bleeding.

We now in 1955 have the advantages of the tremendous advancements in medical science, particularly since World War II, advancements in anesthesiology, and in laboratory and other diagnostic aids. We have supplies of blood unlimited for direct administration to exsanguinating patients. In 1937, only 18 years ago, Arthur Allen<sup>1</sup> advocated having available 500 cc. of citrated blood should the systolic blood pressure fall to 70.

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The first consideration after admission of the patient with acute gastrointestinal hemorrhage is an early estimation of the situation by a careful history and physical examination. The important questions to consider are: what is the age of the patient; is there a history of previous ulcer symptoms, or is there definite knowledge of a chronic ulcer; is the patient vomiting blood—fresh or old—or is the hemorrhage entirely intestinal; how long has he been bleeding and can we estimate the extent of the bleeding.

The extent of the hemorrhage may be estimated by the general condition of the patient, by his blood pressure, pulse rate, and blood count. Abdominal examination will determine the presence or absence of a mass or any localized tenderness.

The immediate management should be directed toward adequate blood replacement. During the first two or three hours, it is very difficult to decide what the fundamental pathology really is, but after the situation is under control there should be better opportunity to evaluate the patient's condition. Continued or repeated hemorrhages should be noted. If the bleeding continues faster than blood replacement is possible, then only is emergency surgery indicated.

Usually within the first 48 to 72 hours the issue as between medical management or operation should be decided. Every patient should be individualized and the issue decided after careful consultation by the internists and surgeons. To route every patient to the operating room within the first two hours after admission is a policy advocated by some but which I only mention to condemn. A very large percentage of gastrointestinal hemorrhages will stop spontaneously after adequate blood transfusions, and time then will be available for careful study and evaluation of each individual problem.

TABLE I  
60 Personal cases

Duodenal Ulcer.....	43	} 86.6%
Gastric Ulcer.....	9	
Gastric Polyp.....	1	
Carcinoma of Stomach.....	1	
Ulcer of Esophagus.....	1	
Tumor of Jejunum.....	1	
Polyp of Colon.....	1	
Unexplained.....	3	

TABLE II  
*Dr. Arthur W. Allen (Massachusetts General)—231 cases massive hemorrhage*

Duodenal Ulcer.....	41%	} 62%
Gastric Ulcer.....	18%	
Gastrojejunal Ulcer.....	3%	
Gastric Carcinoma.....	20%	
Gastritis.....	1%	
Esophageal Varices.....	16%	
Leiomyosarcoma.....	1%	

TABLE III

*Dr. John R. Brown (Detroit Receiving Hospital)—324 cases*

Duodenal Ulcer.....	147	} 246—76%
Gastric Ulcer.....	45	
Marginal Ulcer.....	8	
Probable Ulcer.....	46	
Esophageal Varices.....	34	
Carcinoma of Stomach.....	6	
Hiatus Hernia.....	4	
Miscellaneous.....	8	
Uncertain.....	26	

Although early roentgenologic studies may be considered, perhaps the most reliable diagnosis is based on the physical examination and history, blood studies, careful observation of the patient, and a process of elimination.

In my personal group of 60 cases, peptic ulcer was responsible for 86.6 per cent of the hemorrhages (table I). Allen<sup>2</sup> of the Massachusetts General Hospital reported only 62 per cent of peptic ulcers as the cause of hemorrhage, and in his series gastric carcinoma was responsible for one-fifth of the cases (table II). This is in marked contrast to the experience of Finsterer<sup>11</sup> who stated, and I quote: "Cancer of the stomach very rarely causes profuse hemorrhage. I have performed gastric resection in 710 cases of carcinoma and in only 3 were acute hemorrhages observed before operation." Brown<sup>8</sup>, reporting on 324 cases of gastrointestinal hemorrhage at the Detroit Receiving Hospital, found 76 per cent due to peptic ulcer (table III). Stewart<sup>18</sup> at Buffalo reported on 50 consecutive operations for massive hemorrhage with a 90 per cent incidence of peptic ulcer (table IV). Walters<sup>19</sup> reported sometime ago on a large group of cases at the Mayo Clinic in which bleeding occurred in 25 to 35 per cent of peptic ulcers. From the foregoing and other studies, probably peptic ulcer is responsible for approximately 75 per cent of all gastrointestinal hemorrhages.

Another factor to keep in mind is the influence of age on the prognosis, and the necessity for early operation in the older age group. Older patients, while less apt to spontaneously arrest hemorrhage from arteriosclerotic vessels are, by the same token, less able to withstand operative shock, although no doubt all have been surprised at the resistance these older patients seem to have. In my

TABLE IV

*Dr. John D. Stewart (University of Buffalo)—50 consecutive operations*

Duodenal Ulcer.....	25	} 90%
Gastric Ulcer.....	16	
Marginal Ulcer.....	3	
Gastric and Duodenal Ulcer.....	1	
Gastric Carcinoma.....	1	
Esophageal Varices.....	1	
Gastric Leiomyosarcoma.....	1	
Uncertain.....	2	

series of 60 cases there were 7 deaths; all patients who died were over 50 years of age and 3 were 80 or over.

According to Crohn<sup>10</sup> of the Mt. Sinai Hospital, New York, a study of massed statistics showed a mortality rate from gastrointestinal hemorrhage in patients below the age of 40 years as 4.3 per cent. The rate rises strikingly with age, up to 18.4 per cent in patients between 50 and 60 and to 25 per cent between 70 and 80 years of age.

Medical management with adequate blood replacement may be varied in respect to nasal tube gastric drainage, early or late gastric feeding, and amount and type of sedation, but the result is going to depend upon the control of the bleeding and the replacement of blood lost. It is this bleeding problem which so often is related to the age of the patient. One of a set of generalizations by Breidenbach<sup>7</sup> of Beth David Hospital in New York is that massive hemorrhage in a patient under age 50 usually will stop and rarely is fatal. Patients over 50 years of age are much more liable to recurrence or to have continued bleeding. This, of course, is due to arteriosclerosis and a thickened pipe stem artery in the base of a chronic ulcer. Patients, therefore, above 50 years of age should be considered more seriously and their condition evaluated more frequently, meanwhile adjusting one's thinking for early operation and making plans for a subtotal gastrectomy within that favorable 48 hour period, if it is not certain that the bleeding has stopped.

TABLE V  
*Over-all mortality*

Heuer	
260 cases	13%
Personal Series	
60 cases	12%
Review of	
3817 cases	10%

TABLE VI  
*Medical treatment vs. surgery*

<i>Saltzstein (Harper Hospital, Detroit)</i>			
402 cases hemorrhage			
80% not operated upon	14 deaths	5.1%	
20% operated upon	4 deaths	5.9%	
<i>McDonald (Duluth Clinic)</i>			
363 cases hemorrhage			
282 not operated upon	38 deaths	13.5%	
81 operated upon	6 deaths	9.0%	
<i>Stewart (University of Buffalo)</i>			
107 cases hemorrhage			
42 treated medically	21.4% mortality		
65 operated upon	10.7% mortality		

The question of sex in relation to mortality rate should make little difference in one's thinking. Ivy<sup>15</sup>, in an extensive study of over 5000 case reports, found little variation in the mortality rate in males and females.

What is the over-all mortality rate in massive gastrointestinal hemorrhage? What per cent of cases of gastrointestinal hemorrhage may be expected to be controlled without operation? What is the mortality rate from hemorrhage within the first 48 hours and how much greater is the risk in postponing surgery and then attempting to operate as a last resort? These questions are answered in tables V to X.

The only inevitable death in this series was the old lady with the esophageal ulcer perforating into the aorta. The other 6 patients might have been saved by more adequate or earlier surgery. It is for this reason that a careful review of death rates is important.

As to the question of medical treatment versus surgery, and the question of early or late operation, hesitation about operating is of course due to the risk of a death from gastrectomy. Will patients recently depleted by hemorrhage stand the shock of surgery, and will duodenal stumps and anastomoses properly heal?

With good anesthesia, adequate replacement of blood loss, careful control of blood chemistry and adequate post-operative care I believe the mortality rate of gastrectomy in bleeding patients should not deter one from operating. On the

TABLE VII  
*Estimated average percentages*

Treated Medically	75%	Mortality 15%
Treated Surgically	25%	Mortality 10%

TABLE VIII  
*Early surgery vs. delayed operation*

<i>Amendola (Roosevelt Hospital, New York City)</i>		
173 cases		
39 operated upon within 48 hours	2 deaths	5.1%
15 operated upon late	6 deaths	40.0%
119 treated medically	15 deaths	12.6%
<i>Finsterer (Vienna)</i>		
78 cases—operated upon within 48 hours		
71 subtotal gastrectomies	3 deaths	4.2%
7 gastroenterostomies	1 death	14.0%

TABLE IX  
*60 Personal cases*

35 treated medically	58.3%	2 deaths	5.7%
25 operated upon	41.6%	5 deaths	20.0%
(3 late operations)			



TABLE X  
*Analysis of 7 deaths*

F.80	Esophageal ulcer, perforating into aorta	not operated upon
F.80	Benign leiomyoma of jejunum	not operated upon
F.81	Duodenal ulcer, perforating gallbladder	operated upon late, subtotal gastrectomy
M.69	Duodenal ulcer, hemorrhage and obstruction	operated, gastroenterostomy
M.66	Duodenal ulcer with rupture, hemorrhage and obstruction	operated upon late, gastroenterostomy
M.50	Recurring hemorrhage 1 year following pyloroplasty	anesthesia death before definitive surgery
M.55	Obese. Chronic duodenal ulcer, perforating, with hemorrhage	operated upon, subtotal gastrectomy; died third post-operative day; atelectasis, hyperperxia

other hand, there is no doubt in my mind that there is an increased risk in accepting these patients for gastrectomy. One should feel reasonably satisfied that the hemorrhage is uncontrollable before deciding to operate.

The experience and opinion of Banzet<sup>4</sup> of Paris should be of interest. In a personal communication in which he cites a series of 1000 consecutive gastrectomies, 28 were done for bleeding ulcers with 2 deaths—a mortality rate of 7.14 per cent. Under Banzet's management, patients who have gastrointestinal hemorrhage and in whom ulcer has been known are operated upon immediately. Patients who bleed and in whom ulcer is suspected, have roentgenologic examinations and if an ulcer is demonstrated, operation is done at once. If all diagnostic methods are negative, if bleeding does not stop under medical treatment, or if it recurs, immediate operation is done. Across the Channel from Paris, Gordon-Taylor<sup>12</sup> wrote in the *British Journal of Surgery* that in his experience late operation has been fraught with a far heavier mortality rate than early surgery. He reported a small series of cases with a mortality rate as low as 5.5 per cent. He also described an operation devised by Judin of Moscow for penetrating duodenal ulcer, which consists of rolling a conical duodenal stump snail-fashion to tampon a large ulcer penetrating into the head of the pancreas. Bohrer<sup>6</sup> of New York, maintains that early operation is essential for a lowered mortality rate, and re-emphasizes the fact that gastroenterostomy per se is of no value in stopping immediate bleeding or in preventing recurrence.

The small percentage of patients, who at operation fail to disclose the cause of the hemorrhage, pose a serious problem. Should a blind gastric resection be attempted on this group? Gray<sup>13</sup>, from the Mayo Clinic reported 48 such cases in a series of 3500 cases of patients with ulcer who were operated upon. In 28 the abdomen was closed without any further surgery than the exploration with or without a gastrotomy or duodenotomy. In 63 per cent of these patients bleeding recurred. In the other 20 in whom a blind gastrectomy was done only 11 per cent had recurrence of bleeding. Gray believes the surgeon is justified in doing a partial gastrectomy if, after meticulous search of the stomach, duo-

denum, small and large bowel no lesion is found. Ferguson<sup>5</sup> of Philadelphia and Stewart<sup>18</sup> of Buffalo agree with Gray, and strongly advise blind subtotal gastrectomies in such conditions, with careful search within the opened end of the stomach and duodenum for a hidden ulcer or erosion or polyp. Wangansteen,<sup>20</sup> from the University of Minnesota, holds that the gastric membrane frequently is, if not usually, the source of bleeding and a 75 per cent resection usually will rescue these patients from hemorrhage. Others—notably Warren Cole<sup>9</sup> of Chicago—warn against the blind gastrectomy lest an undiscovered lesion outside of the stomach is responsible for the bleeding and surgery will have added an unnecessary radical procedure to a desperate situation.

Patients with massive gastrointestinal hemorrhage comprise a group of very sick patients, upon whom it sometimes requires more courage to postpone operation than to operate. The surgeon on the firing line is faced with a great responsibility, although in this day of modern surgical technic and teamwork surgeons are becoming increasingly more courageous, and every patient over 45 or 50 years of age may be considered a potential surgical case if seen within the first 24 to 48 hours.

#### SUMMARY

In summary, remember these points:

1. Seventy-five per cent of massive gastrointestinal hemorrhages are caused by peptic ulcer.
2. Seventy-five per cent may recover under conservative medical management with adequate blood replacement.
3. The mortality rate in patients under 50 years of age is low but increases rapidly with age.
4. Select patients for operation after careful individual study.
5. Close cooperation between internist and surgeon is essential, especially in the early 48 hour period.
6. Adequate blood replacement is essential.
7. Gastric intubation and suction may be helpful not only to estimate the amount of bleeding, but to reduce gastric acidity.
8. Delayed operations have a rising mortality rate—perhaps as high as 40 per cent.
9. If operation is attempted, a radical subtotal gastrectomy should be done. The optimum time for operation usually is within the first 48 hours—when the mortality rate should be low, perhaps 5 per cent.
10. Gastroenterostomy is futile to control hemorrhage or prevent recurrence.
11. When faced with the unusual situation in which the cause of bleeding cannot be found consider a blind subtotal gastrectomy, but be very sure there is no other cause for bleeding, such as esophageal varices, hiatus hernia or tumors of the small intestine.
12. With increased concentration on the care of the acute gastrointestinal

hemorrhages, especially in the older age group, the over-all mortality rate should be reduced.

This approach to the management of gastrointestinal hemorrhage offers nothing new. Perhaps to bring to your consideration this review of the experience of others in the management of 3817 cases, and a summary of my personal experience in a small group of 60 cases, may sharpen your judgment when faced with a decision in the handling of these acute and serious emergency problems.

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## PERIPHERAL ARTERIOSCLEROSIS IN DIABETICS AND NONDIABETICS

### ANALYSIS OF RESULTS FOLLOWING LUMBAR SYMPATHECTOMY

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The beneficial effects of lumbar sympathectomy for the treatment of peripheral vascular diseases of the lower extremities have been reported by many in the past several years.<sup>1-14</sup> It generally is agreed that the improvement in peripheral circulation in this group of patients is due primarily to the release of vasospasm and the development of the unaffected collateral channels. This additional increase in blood supply to the distal structures and tissues in many instances is adequate enough to maintain integrity of the extremity and avoid the need for major amputation, or, if the latter is necessary, frequently it can be accomplished at a lower level. In addition to increase in blood flow, the various types of pain resulting from ischemia are decreased or eliminated because of improvement in circulation and because of interruption of the vasosensory supply to the vascular tree of the extremity. This vasosensory supply passes via the sympathetic pathways to the lumbar, and in some instances to the lower dorsal, portions of the sympathetic chain and spinal cord.

In the past and even today, in many areas of this country, when a major amputation becomes necessary for peripheral arteriosclerosis with or without diabetes, it was, and frequently is, done above the knee. The impression is that the disease process is more severe, and therefore the final outcome of therapy of any type is less favorable in the group of patients with diabetes. However, a careful study of both groups by our present methods of management indicates a more favorable prognosis and, in many instances the results of therapy are equal, if not better, in the diabetic group of patients.

Recently, a study of our cases of 220 lumbar sympathectomies made upon 159 male patients for the treatment of peripheral vascular diseases of the lower extremities at this hospital showed 49 (28 per cent) patients were treated for peripheral arteriosclerosis. Of this number 20 (40 per cent) had diabetes.

#### AGE INCIDENCE

The average age in both groups was 59 years, with over 40 per cent of the patients beyond the age of 60 years (table I).

The average duration of symptoms was two years in the nondiabetic groups and only one year in the diabetic cases. Pain was the chief complaint in 90 per cent of the patients in both groups. The most frequent finding was gangrene and/or ulcer. This was limited to the toes and/or foot in all instances. Cellulitis and edema occurred frequently (table II).

From the Department of Surgery, Veterans Administration Hospital, Des Moines, Iowa.

TABLE I

*Age groups*

Diabetics	Age	Nondiabetics
1 (5%)	40-50	0
10 (50%)	51-60	16 (55%)
7 (35%)	61-70	11 (38%)
1 (5%)	71-80	2 (7%)
1 (5%)	Over 80	0
Total..... 20		29

TABLE II

*Local physical findings*

Diabetic	Findings	Nondiabetic
8 (40%)	Gangrene	10 (34%)
15 (75%)	Ulcer	8 (28%)
13 (65%)	Cellulitis	8 (28%)
2 (10%)	Edema	5 (17%)

TABLE III

*Sympathectomies*

Diabetic	Side	Nondiabetic
9 (45%)	Right	4 (9%)
3 (10%)	Left	10 (23%)
8 (45%)	Bilateral	15 (68%)

Preoperative procaine lumbar sympathetic blocks were done in 89 per cent of the nondiabetic group and in 100 per cent of the diabetics. The response was favorable in 75 per cent of the diabetics as compared to 69 per cent in the nondiabetics. However, the results of this test were not the sole determining factor in selection of candidates for sympathectomy.

Twenty-eight sympathectomies were done in the diabetic group and 44 in the nondiabetics. Eight were bilateral in the former group, and 15 in the latter group (table III).

## RESULTS

*Postoperative Complications.* In the diabetic group only 2 (10 per cent) patients developed complications; these were ileus and acute thrombophlebitis. In the nondiabetics 8 (27 per cent) developed postoperative complications; these are listed in table IV.

*Amputations.* Major amputations were done following sympathectomy in 6 of the 8 diabetic patients who had gangrene of the toes or foot. In 3 (38 per cent) the amputation was above the knee, and in the same number it was below the knee. In 1 patient in each of the above groups the amputation was done bi-



TABLE IV  
*Non-diabetic postoperative complications*

Type	Number
Cerebral-vascular accident.....	1
Embolus, right leg.....	1
Embolus, pulmonary.....	1
Ileus, paralytic.....	2
Phlebitis, acute.....	1
Wound, infection and hematoma.....	2
Total.....	8

TABLE V  
*Major amputations*

Diabetics	Site	Nondiabetics
4 (40%)	Above knee	3 (50%)
4 (40%)	Below knee	3 (50%)
2 (20%)	Transmetatarsal	0
Total.....10		6

laterally. In 2 (25 per cent) patients transmetatarsal amputations were done. In all, 10 major amputations were necessary. Reamputation was not necessary in any of this group, and the stumps healed within a reasonable period of time. In this series 6 or 60 per cent of the major amputations were done below the knee.

In the nondiabetic group, 5 of the 10 patients with gangrene of the toes or foot required major amputations. Of this number 3 (60 per cent) were done above the knee, and in 2 (40 per cent) patients, amputations were done below the knee (1 patient bilateral). In all, 6 major amputations were done. Secondary closure became necessary in 1 patient in this group, and this was in an above the knee amputation. In this series 3 or 50 per cent of the major amputations were done below the knee (table V).

The evaluation of the postoperative results was based on follow-ups from 4 to 36 months. The results were considered excellent to good in 55 per cent of the diabetics and in 65 per cent of the nondiabetics. The poor results occurred in 2 (10 per cent) of the diabetics as compared to 4 (14 per cent) in the nondiabetics. The average age in both groups with poor results was 66 years. There were no deaths in either group.

#### COMMENT

Lumbar sympathectomy continues to be a valuable aid for increasing the circulation to an extremity with impairment from peripheral arteriosclerosis without undue risk, in spite of the fact a great number of patients in this category are in the older age groups. Frequently they have, in addition to circulatory impairment, other systemic diseases, particularly cardiorenal,

which imposes some hazards to postoperative morbidity and mortality rates. Sympathectomy in those patients with impending gangrene or gangrene prior to amputation has permitted us in the past 10 years to adopt a more conservative attitude about amputations. With the use of antibiotics and earlier control of the diabetics, we have been able in the past several years to do over 80 per cent of major amputations below the knee. The stumps in these patients have been entirely satisfactory and functional.

It is apparent from this comparative study that the diabetic patient with peripheral arteriosclerosis fares as well as the nondiabetic patient under similar circumstances. That the same conservatism can, likewise, be applied in the management of the diabetic patient. A greater number may require major amputations; however, the level of amputation and the wound reparative power can be similar to the nondiabetic patient.

#### SUMMARY

A comparison of the results of lumbar sympathectomy in the treatment of peripheral arteriosclerosis of the lower extremities of diabetics and nondiabetics is presented.

The favorable outcome in both groups is similar. The diabetic patient appears to be no greater surgical risk, and when a major amputation is required the level of amputation can be at as low a level as in the nondiabetics. A more conservative attitude toward major amputations in both groups is warranted and the over-all results can be improved if sympathectomy precedes the amputations by several weeks.

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## EMERGENCY MANAGEMENT OF ACUTE LARGE BOWEL OBSTRUCTION DUE TO CARCINOMA OF THE COLON

### NOTES ON SOME PHYSIOLOGIC AND PATHOLOGIC FACTORS RELATED TO TREATMENT\*

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Acute large bowel obstruction by any definition is a surgical emergency. The best of conservative treatment requires constant surgical supervision, and the decision to operate may be momentary. However, operating upon a patient immediately on admission to the hospital may incur an error. We should like to develop the thesis that judicious conservative management and prompt surgery are by no means mutually exclusive. This is not only a clinical impression but is based on some pathologic and physiologic studies upon which we will touch briefly.

Our experience with carcinoma of the colon discloses that about 20 per cent of the patients are acutely obstructed on admission to the surgical service. Of 341 cases of carcinoma of the colon,<sup>3</sup> 36 patients were partially, and 33 were completely obstructed; all of these 69 patients were emergency admissions. An additional 299 cases were studied and showed that in 20 per cent of the patients intestinal obstruction was involved as an immediate problem on admission to the hospital. The differentiation between complete and incomplete obstruction often is difficult and perhaps academic. The practical approach is to realize that these patients presenting either a diagnostic or therapeutic problem require urgent consideration. The primary objective is to salvage out patients from the immediate emergency without prejudice to the eventual definitive resection. The basis for this salvage must be a complete and accurate medical as well as surgical diagnosis.

Analysis of the mortality rate of our 69 cases of obstructing carcinoma of the colon indicated the major importance of medical complications and concomitant medical disease. More often than not, these complications were the cause of death in the geriatric cancer patient and not the particular type of operation that the surgeon may have chosen to do. Table I illustrates the problems encountered as far as age, concomitant disease and extent of malignancy are concerned. Unqualified immediate surgery might lead one to miss serious medical diseases often found in this older aged group. Also, many of these acutely ill people require general supportive therapy, as well as specific treatment for medical conditions.

The surgical differential diagnosis was important from the view of primary

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TABLE I  
*Carcinoma of the colon with obstruction with analysis of deaths*

<i>Thirty-three complete obstructions with five deaths</i>		
*1. J. L.	F-W-68	Transverse colostomy at another hospital. Carcinoma of rectum not resectable. Admitted to Hahnemann Hospital because of saddle embolus of distal aorta.
2. E. F.	M-W-70	Palliative obstructive resection. Extensive liver metastasis. Death occurred over two months postoperative.
*3. A. H.	F-W-79	Obstructive resection. Patient had gallop rhythm with advanced cardiac disease.
*4. M. C.	M-W-75	Transverse colostomy. Patient admitted in moribund state. Pulmonary complication—embolus or massive atelectasis.
5. E. C.	F-W-70	Obstructive resection, palliative. Extensive metastasis. Patient died two months postoperative.
<i>Thirty-six partial obstructions with three deaths</i>		
1. E. L.	F-W-77	Transverse colostomy. Patient had serious pulmonary complication, bronchogenic carcinoma.
*2. C. C.	M-W-67	Cecostomy. Severe cardiovascular disease proved by autopsy.
3. E. H.	M-W-69	Patient admitted in moribund state. Not operated upon. Given 1000 cc. whole blood. Died 60 hours after admission.

\* Acceptable as operative mortality. Only four patients so considered.

disease (adjacent or multiple carcinoma, diverticulitis, polyposis, volvulus, fecal impaction, double lesion, and acute abdominal conditions). We are finding fecal impaction, with and without diverticulitis, with increasing frequency. The double lesion as well as the coexistence of polyps in other portions of the colon, requires alert appraisal. Most of the cases of acute abdominal conditions in this series were caused by a distended cecum with circulatory embarrassment or perforation of a carcinoma of the cecum.<sup>1</sup> Of 24 cases of carcinoma of the cecum, 2 were perforated on admission and were sent in with the diagnosis of perforated appendicitis.

TABLE II  
*Factors suggestive of small intestinal obstruction in 69 cases of acute large bowel obstruction*

Hyperperistalsis.....	16
Repeated vomiting (more than one time in 24 hours).....	46
Fecal vomiting.....	9
Colicky pain.....	62
No bowel movements	
1 to 2 days.....	4
3 to 14 days.....	30
No flatus passed over 24 hours.....	10
Flat roentgenogram taken.....	42
Small intestinal distention	
Slight.....	3
Moderate.....	9
Marked.....	9

Of the 341 patients, 49.4 per cent were males and 50.6 per cent were females. However, of the 69 patients with obstruction, 70 per cent were females. Apparently, females were less apt to be distressed by obstipation and waited longer before seeking medical advice. Scout roentgenograms of the abdomen on these emergency admissions in 9 of 69 patients showed marked small bowel distention. Table II suggests the diagnostic problem that may confuse the evaluation of the emergency admission. Clinically, with colicky pain, vomiting, electrolyte imbalance, these patients present the picture of an associated small bowel ileus in addition to large bowel obstruction. In an occasional patient, this small bowel obstruction is simply mechanical and caused by involvement of a loop of ileum directly in the malignant inflammatory complex of the colon lesion. In the great majority of patients, however, the small bowel distention is secondary to the large bowel obstruction. Disturbances of pressure gradients, reverse peristalsis, ileocecal regurgitation, improper function of the ileocecal sphincter and terminal ileum contribute varyingly to produce this condition.

Experimental work<sup>2</sup> suggests that the closed colon loop is indeed a *tension closed loop* and deleterious effects probably are due to continual ileal emptying into the colon. The experimental animal—dog and white rat—survives indefinitely with the entire colon closed at both ends with ileal emptying excluded by anastomosing the terminal ileum to the rectum. We recently reported such a series and now add to it some long term animals operated upon without the benefit of antibiotic therapy.<sup>4</sup> Several months after creating the closed colon loop there was no evidence by gas analysis of the accumulation of hydrogen sulphide or other gases of putrefaction in the excluded and closed colon, as shown in table III. The principal gas was nitrogen. Consequently, the importance of tube suction and nothing by mouth assumes added significance. This regimen should at least break the gradient of ileal pressure emptying into the cecum and avoid the addition of swallowed air to the gaseous component of the obstructed intestinal content. Tube suction is not used to directly decompress the colon. Experimentally, at least, the colon can take care of itself. Tube suction is used to help counteract the mechanisms associated with the emptying of small bowel material into the cecum and the accumulation of liquids and gas in the small bowel itself.

The site of the obstructive lesion, as well as the pathologic character of the

TABLE III  
*Analysis of gas in closed colon loops*

	Dog C-13	Dog C-16	Dog C-18	Dog C-19
Centimeters of gas recovered.....	41.2	51.1	30.4	23.6
Hydrogen sulphide.....	0	0	0	0
Carbon dioxide.....	6.3%	6.0%	8.8%	8.8%
Unsaturated hydrocarbons.....	0	0	0	0
Oxygen.....	0	0	0	0
Methane.....	10.1%	8.6%	6.2%	6.2%
Nitrogen.....	83.6%	85.4%	85.0%	85.0%



TABLE IV  
*Analysis of causes of obstruction*

	36 Partial	33 Complete
Annular constricting lesion.....	35	33
Necrosis, ulceration.....	11	11
Mucous forming.....	3	1
Inflammation, edema, abscess.....	13	14
Obturation, obstruction, barium.....	3	5
Obturation, obstruction, fruit pits.....	0	2

The pathologic condition noted in each patient was the outstanding process present.

obstruction, are important to consider in the emergency operative treatment of the obstructed colon. Twenty-three of 129 patients involved the right colon, 7 were in the cecum, 12 in the ascending colon, and 4 were in the proximal transverse colon. In all of our patients it was an acute inflammatory process that actually caused the blockage. The pathologic mechanism causing the acute obstruction in the colon involves more than tumor tissue obstructing the lumen. In most patients the acute syndrome appeared only when inflammation was present. This was due to general pathologic processes like infarction, hemorrhage, infection, degenerative changes in the tumor, or obturation of a narrowed lumen by feces, fruit pits or even barium. Table IV presents an analysis of lesions removed at the operating table and illustrates this point. The pathologic condition noted in each patient was the outstanding process present. In many patients, besides the constricting lesions, all of the types of pathologic changes listed were present. Furthermore, a barium enema showed the presence of spasm in many instances. Therefore, unlike the case of small intestinal obstruction, the actively obstructing process in these patients resides in the bowel wall itself, is an acute inflammatory process and often is reversible. Once the colon is decompressed, one often witnesses a reopening of the complete block, due to subsidence of the acute inflammatory process. Clinically, we know that these obstructions do open up spontaneously. Of the patients with obstruction, 26 per cent gave a history of 1 to 4 previous episodes of complete obstruction relieved at home by enemas and emesis. Among the patients not having obstruction on admission, there were similar instances.

In 69 patients, 42 received some form of conservative therapy in an attempt to decompress the bowel and restore the fluid and electrolyte balance. In 4 patients the attempt was successful. Patient A. M. is an illustrative case in point.

#### CASE REPORT

A. M., a white male aged 69, was admitted on May 31, 1947 to the medical service because of colicky pain, vomiting, and abdominal distention. In the preceding 12 months he had 3 similar attacks, all relieved by repeated enemas. On this admission he was relieved by enemas. In the course of doing a barium enema on June 2, the patient's colon became completely obstructed. The medical observers now thought that he would need a cecostomy since roentgenographic study had revealed the obstruction to be at the hepatic flexure.

He was a 212 pound man, acutely ill, with distended abdomen and vomiting. Further-

more, he had diabetes and this condition was not well controlled. We decided to treat him conservatively over night with the idea of doing a cecostomy in the morning. This decision was not made as a matter of convenience but with the hope that we could improve his general condition. The whole regimen of conservative therapy, including tube suction, antibiotics and antispasmodics were started. Special attention was given to his diabetic state. By morning obviously he was improved. Therefore, emergency decompression operation was postponed. By the next day, he was no longer a problem of acute intestinal obstruction. He passed flatus, and on June 8 he began to have bowel movements. He was now prepared with 16 grams of sulfasuxidine a day and operated upon on June 10. A right colon resection was done with an end-to-side ileotransverse colostomy. The pathologic report was encircling adenocarcinoma of the ascending colon causing almost complete closure of the lumen. The lesion showed marked ulceration and mucoid degeneration. The adjacent bowel wall was edematous and acutely inflamed. This patient made a good recovery from the operation and was discharged on June 24, 1947. A follow-up examination in August 1950 showed him to be entirely well with no complaints. He died May 21, 1952, with gangrene of the foot and leg, diabetes mellitus and cardiac failure. His physician reported no large bowel symptoms.

## DISCUSSION

In acute large bowel obstruction we should like to support the teaching that there are not two competitive schools of treatment, medical and surgical, diametrically opposed. There is one reasonable method wherein diagnostic and therapeutic efforts are logically correlated and wherein surgical decompression has its proper and important place. An enthusiastic and well directed program of conservative treatment which has no blind spots and no prejudices can accomplish much, even in a matter of a few hours. Table V outlines a basic approach to the treatment of large bowel obstruction. For the desperately sick patient who requires immediate surgical decompression, certainly this much preparation is mandatory. For lesions of the cecum and proximal colon, the operation of choice is primary resection. This is more feasible if the patient has even 12 hours of adequate preparation. Although the majority will require cecostomy or colostomy, every patient will benefit from a program of supportive therapy. Furthermore, at least 10 per cent will escape the need for emergency surgery.

TABLE V  
*Scheme of management for emergency admissions*

Diagnostic	Therapeutic
1. Complete history and physical examination	1. Nothing by mouth
2. Laboratory work—routine and special chemistries as indicated	2. Continuous tube suction: Levine or Cantor (If long tube is used, check position by roentgenogram)
3. Scout films of abdomen	3. Antibiotics—penicillin, streptomycin; intravenous terramycin if indicated
4. Chest roentgenogram	4. Antispasmodics (demerol, atropine, etc.)
5. Electrocardiogram	5. Warm saline and soda bicarbonate enemas, carefully given
6. Sigmoidoscopy	6. Parenteral fluids, electrolytes and blood transfusions as indicated
7. Barium enema if indicated	
8. Medical consultation if indicated (for associated metabolic, cardiopulmonary disease, etc.)	

Unfortunately, large bowel obstruction does not seem to ring the same urgent bell as small bowel obstruction. Consequently, the first survey of the patient and the very first emergency management often is left in inexperienced hands. In large bowel obstruction due to carcinoma, the circulation in the colon wall is embarrassed insidiously by rising hydrostatic pressure in the colon lumen. The pathologic process is slower and less spectacular than in the case of small bowel obstruction but none-the-less unrelenting in its course towards a fatal climax. These people, most often old and with the added burden of cancer, coming in as emergencies, have been acutely ill for one to six days. Their physiologic margin is attenuated and the homeostatic mechanisms are on the verge of exhaustion. Eight hours delay at this stage does make a difference. Also, it is a mistake to stubbornly adhere to conservative treatment if progressive improvement is not soon evident. Ordinarily, well within 24 hours a decision may be made as to the need for colostomy. In the newly admitted patient presenting signs suspicious of a strangulated cecum the need for operation is urgent. Once the decision is made to operate, there should be no procrastination. Perhaps the most common fault of all is to make the correct appraisal and decide that colostomy must be done and then delay 24 to 96 hours before acting. If surgical decompression must be done, the patient who is prepared systemically withstands the operation much better and the surgical procedure is facilitated. It would seem that the concept of early surgery is generally preferable for the correctly diagnosed and properly prepared patient.

#### SUMMARY

In a series of 640 patients who had carcinoma of the colon, 20 per cent were obstructed. The diagnostic and therapeutic problems as related to emergency management are reviewed.

The concepts of conservative treatment and surgical decompression are examined on the basis of some physiologic and pathologic factors. The two are correlated and considered complementary in the proper regimen of treatment.

The majority of patients with acute large bowel obstruction due to carcinoma require surgical decompression. About 10 per cent of the patients respond well to conservative therapy and escape emergency surgery. A few lesions of the right colon and cecum may be definitively resected.

Regardless of the result, every patient is benefited in the first 12 to 24 hours by a diagnostic and therapeutic program of management as outlined.

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## IMPACTIONS OF THE RECTUM AND COLON

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Impactions of the rectum and colon occur more frequently than the literature suggests. Their diagnosis and treatment usually are passed over very lightly. The complications and morbidity associated seldom are diagnosed as such and are even more rarely reported. Because of the nature and location of the condition, many patients treat themselves. The ones called to the physician's attention are the ones that fail to respond to self treatment. Too often the physician does not go to the trouble to examine and treat these patients. As a result, the condition recurs and either results in a chronic ailment or acute obstruction.

Impactions are masses that accumulate in the intestinal tract that the normal contractions are unable to expel. They most often are found in the rectum and sigmoid colon, but may occur at any level. They may be very minute, as are those that occur in diverticula and appendices, or they may weigh several pounds. They may be hard and calcified as in colon stones or semisolid or putty-like. Those caused by ingestion of barium or following barium enema are very hard and may remain in the colon for months. On occasion, if above a stricture, they may cause a complete obstruction necessitating an emergency operation. Foreign bodies, such as stones or hair balls, may remain in the colon for years. They may move along the colon, depending upon peristalsis, and cause varying symptoms according to their locations. Their shape is determined by location and the degree of dilatation caused.

Impactions are more frequent in children and in elderly people. In children or infants, when a considerable part of the diet is milk, the impaction most often is in the rectum, but may involve the whole colon in elderly people, especially in those who are inactive or bedridden because of senility or paralysis. Here again milk products may play an important role. In postoperative patients when sedatives, narcotics and liquid diets are prescribed, the tendency to impaction is most frequent. Mechanical obstruction may be caused by adhesions, acute angulation, over-active sphincter at rectosigmoid or anus, rectocele, and inflammatory strictures such as those caused by lymphopathia or diverticulitis. Tumors of the colon and congenital deformities may be causative factors.

### SYMPTOMS AND DIAGNOSIS

The symptoms vary with the location, the degree of obstruction, or associated pathology. With rectal impactions there may be frequent stools and a continuous desire to defecate. This often is interpreted as diarrhea and the true condition not suspected. Impactions of the sigmoid or complete colon may cause abdominal cramps, distention, nausea and elevation of temperature and leukocytosis. When

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diverticula are involved the symptoms, except for nausea, resemble appendicitis on the left side, being those of acute or chronic appendicitis, depending upon the degree of inflammation or obstruction. Should they suppurate the symptoms are the same except that general peritonitis is rare.

The diagnosis is made by rectal and bimanual examination. Bimanual examination should be made on male as well as female patients. If the mass can be palpated, pressure usually will cause an indentation which remains. The presence of a valve or rectal wall between the mass and examining finger may be very confusing. Concretions on the other hand are so firm that they do not give the impression of a tumor or inflammatory growth. The mass, depending upon its location, must be differentiated from tumors of the colon, inflammatory or otherwise. Extrensic tumors such as fibroids, endometriosis, pelvic inflammatory masses and pericolic inflammation should be ruled out. When the diagnosis is not obvious, proctoscopic and roentgenologic examinations may be necessary.

#### TREATMENT

The treatment may be very simple or complicated. In the case of soft rectal impactions the mass should be broken up manually followed by enemas of normal saline or warm oil and glycerin enemas. When hot oil enemas are used the temperature should be checked either by thermometer or by holding the finger in the solution for 20 seconds. This precaution is of paramount importance, especially if the patient has had a sedative. The bowel wall is not sensitive to heat and a retained hot oil enema can cause serious damage to the bowel. The thin rectal valves are burned from both sides and the damage may increase rather than relieve the condition. In consultation on 4 such patients 1 required a colostomy for relief of pain and bleeding. The possibility of a law suit against the physician or hospital may be involved. In 2 of these patients the skin on the buttocks was burned where the rectal tube came in contact with it. One of the patients who had been dismissed from the hospital had abdominal distention and severe pain. Digital examination showed an obstructive mass in the rectum which was friable and bled profusely. Until a further history was taken and an anoscopic examination was done, the clinical diagnosis of friable malignancy was made. The patient was hospitalized for a colostomy. Fortunately, the true condition was recognized and palliative treatment instituted. The patient recovered without surgery.

When the use of a peroxide enema is necessary to disintegrate the impactions it should be diluted to 15 to 25 per cent. A peroxide enema should never be given unless the exact strength be designated. Full U.S.P. strength peroxide will cause severe burning of the bowel. Before using peroxide a careful examination should be made to be sure the bolus is not too large to pass through the anus, otherwise the bowel may be ruptured or a diverticulum blown out. Never underestimate the power of this solution.

If the impaction has become calcified, enemas will not dissolve it. The removal requires hospitalization. Under anesthesia the anal canal may be dilated and the mass removed. When masses are very large, a posterior proctotomy will be necessary. On one occasion, small obstetrical forceps were used. Semisolid masses



above the rectosigmoid should be treated with oil given orally and by enema. Castor oil is most likely to relieve patients who have early impaction. The proctoscope may be used in attempts to break up the hard masses that do not respond to oil and enemas. Should all the above measures fail, surgical intervention will be necessary. Should the patient's condition not be acute, palliative treatment may be used over a long period of time in the hope that the mass will dissolve or pass. In this type of case, treatment of the inflammation and edema may help to release the mass.

Impactions in diverticula usually respond to oil retention enemas left in overnight. Following a warm water enema, the concretion often will be released. Where diverticulitis is suspected, one is justified in resorting to conservative measures. However, should the diverticula rupture and form an abscess, surgical drainage, with or without a proximal colostomy, may be necessary.

Following the relief of the impaction a soft non-residue diet, avoiding milk products should be given. When the patient's symptoms have subsided, an attempt should be made to find and relieve the cause. In rectal impactions, anal pathology should be corrected. Rectal stricture and tumors may require surgery. If the causative factor is a rectocele this can be controlled by a corrected diet and enemas every two to three days. Should recurrences be frequent, surgery may be resorted to.

If the impaction is above the rectosigmoid, proctoscopic and roentgenologic studies should be made. Tumors or adhesions may require surgical treatment. In children, dilatation above the rectosigmoid can be corrected by medical treatment. In adults the dilatation usually has become chronic. I firmly believe most early cases of so-called Hirschsprung's disease are chronic dilatations due to a spastic muscle at the rectosigmoid and a predominate diet of milk and milk products.

#### CASE REPORTS

Case 1. This was a 4 year old boy whose rectum and colon were impacted to the point that it almost filled the abdomen. Anal dilatation, removal of the impaction, and correction of his diet gave complete and permanent relief.

Case 2. This was a 9 year old boy who had soiled his clothes for a period of four years. He was seen by a psychiatrist, neurologist, and several physicians. He had had spinal punctures, and roentgenograms of spine and skull. Because of offensive odor he had ostracized himself. Complete recovery followed withdrawal of milk products and medical treatment.

Case 3. This was a 6 year old girl with all the signs and symptoms of acute appendicitis. At operation a normal appendix was found. The colon was impacted throughout. Diet and medical treatment has prevented a recurrence.

Case 4. This was a 4 year old boy with a palpable tumor in the epigastrium which was explored. The tumor was resected and end to end anastomosis done. Examination of the specimen revealed a fecal impaction.

#### SUMMARY

An attempt has been made to evaluate impactions, their causes, diagnosis and treatment. Special emphasis has been placed upon the danger of hot oil enemas. Caution is expressed concerning peroxide enemas. Cases are presented to illustrate the treatment of impactions. Milk products are suggested as an etiologic factor.

## APPENDICITIS 1930 TO 1955

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*"Is it time to stop talking about appendicitis? No! It is just the time to begin talking about appendicitis and talking both seriously and emphatically about it."* Thus thundered John B. Murphy 40 years ago. The need for such a challenge still is as compelling to a degree comparable to that of 1915. Is it not really a fact that we have stopped talking about appendicitis? Have we not relegated this most frequent of acute abdominal diseases to the pigeonhole of solved problems and concerned ourselves largely with what we consider more important and more modern matters?

The foregoing paragraph formed the introduction to a paper read by one of us (H. A. R.), Oct. 9, 1930, under the title "The Tragedy of Appendicitis". Three years prior to that date, a monograph on "Appendicitis" by one of us was published, a book of 370 pages and 11 chapters. The basic intention in this publication was to set forth the disease, appendicitis, as an entity, first considering its historic development and in order: its anatomy, physiology, etiology, pathology, symptomatology, complications, diagnosis, prognosis, and treatment. Emphasis was placed upon the pathologic course of appendicitis as being, then and even now, little understood and appreciated. It was not enough, we thought, to look upon the disease represented by an attack of acute appendicitis as an emergency episode only, ripe and ready for immediate operation. There was a history to be taken and in the overwhelming majority of instances previous attacks had occurred, some too mild to be recognized or, if a diagnosis had been made, the case had been passed up for the interval operation. The patient, when asked if this was his *first* attack of appendicitis almost invariably would reply in the affirmative; but upon careful questioning he would confess previous abdominal disturbances, cramps, and colic, *acute indigestion*, at intervals covering a period perhaps of months or years; so that, instead of this being his *first* attack, the instant condition was his *worst* attack.

During the period of 1927 to 1937 we wrote several papers, all stressing the pathologic and clinical sequences. The paper which was read at the first regular meeting of the Southeastern Surgical Congress March 9, 1931, was entitled "The Appendix as a Focus of Infection", founded upon the observations of Dieulafoy (1898), that "*appendicitis results from the transformation of a part of the appendicular canal into a closed cavity, which becomes a focus of infection and intoxication, due to the increased virulence of the imprisoned microbes*". He spoke of "*toxi-appendicitis*", and suggested that it was more dangerous than the perforating variety, and affixed to it the term "*appendicemia*". The idea of focal infection first was introduced about 1903 by Frank Billings, who charged most of the

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sources to the teeth and tonsils, reminding us of the name "*abdominal tonsil*" as applied years ago to the vermiform appendix: an analogy very striking when we consider the amount of lymphoid tissue in and around the appendix.

Other contributions were: "The Complicating Lesions of Appendicitis" being the pathologic processes and direct alliances originating in the course of an infected appendix; "Side Lights on the Pathology of Appendicitis", read before the Southeastern Surgical Congress in 1933 in which the following statement was made: "There seems to be a disposition to neglect and even to ignore the pathologic significance back of the clinical events. We seem deeply concerned with the story of the acute attack, with the symptoms by which the diagnosis is made and with the physical examination which completes the usual sequence of study, but unless there is kept in the mind's eye an image of the pathologic sequences of appendicitis in their entirety, no true conception of the malady can be acquired"; and "Notes on The Physiology and the Pathology of the Vermiform Appendix", indicating that the realization of a possible function in this vestigial structure and a working knowledge of its morbid processes would be of help in reducing the mortality rate of appendicitis.

The pathology of appendicitis has been regarded too lightly. Its morbid anatomy is a definite characteristic process, described in four stages as: endoappendicitis, parietal appendicitis, periappendicitis, and para-appendicitis. The process may go on to fulfillment without passing through these periods, resulting in resolution, leakage, perforation, or gangrene. Also conveyance of bacteria to the wall of the appendix through the blood stream has been proved. Destructive lesions of the appendix most often are due to embolism of the appendiceal artery as it passes through the mesoappendix opposite the upper level of the gangrenous area.

Our opinion was that such extreme pathologic lesions of the appendix scarcely could occur primarily overnight, independent of previous disease. Surely a normal, healthy appendix conceivably could not perforate or become gangrenous or even suppurate in a few hours' time. How often have we found a perforated appendix in a child four hours after the initial pain! The acute attack is not the disease itself, but a knock at the door. The disease as a whole, then, represents an accumulation of pathologic changes in a rudimentary, nonresistant, closed-end tube. And in a once diseased appendix damage proceeds between, as well as during, the acute attacks; so that one might correctly assert that *once appendicitis always appendicitis* until its pathology either undergoes resolution or gangrene, or the little worm is cast out forever. Life insurance statistics showed that only 2 per cent of patients escaped recurrence following the first attack. In other words, 98 per cent had one or more repeated attacks. The presence at operation of previous pathology in the form of "old" adhesions, as well as the "new" adhesions and other signs of inflammation and infection, is proof positive of such an assertion. If medical men in general and surgeons in particular would think seriously of the pathology of the disease; make an immediate gross examination of all specimens removed, always cutting open the appendix at once following the operation, dangerous delay and criminal cathartics might be eliminated

forever, and most patients would come to the operating table with only a mildly morbid appendix, removal of which would be simple and safe. Familiarity with its pathology is the surest way to obtain this ideal. That was our slogan in the nineteen hundred and thirties.

At that time our salient summation was: 1. There is no medical treatment of appendicitis. 2. There is a crying need to remind both the medical profession and the people that procrastination in the beginning of acute appendicitis and purgatives at any stage of the disease constitute the double unpardonable sin—the twin factors of fatality in appendicitis. 3. Instruction of the laity and renewed concern of physicians of the dangers of delay and the giving of laxatives is demanded. 4. Whenever gangrene or perforation of the appendix occurs someone has blundered. 5. The tragedy of appendicitis is that even one human being should ever die of the disease.

Have we so soon forgotten the man who gave a habitation and a name to this disease? It was the master mind of Reginald Heber Fitz of Boston, a teacher of internal medicine, which in 1886 penetrated the fog of hazy knowledge which had been accumulated for over 150 years, and singled out the vermiform appendix as the original lesion in acute infections of the right iliac fossa. He coined and first used the word "*appendicitis*" which ever since has been applied to this universal disease. As a competent pathologist Fitz sought for the seat of the disease and found at his autopsies that, in most of the fatal cases of so-called typhlitis (*cecitis*), the cecum was intact, while the appendix was ulcerated and perforated. Further, he called attention to differences in length, position, and patency of the appendix, as bearing upon clinical symptoms and insisted upon early operative intervention, actually pleading with the surgeons to operate. His historic paper was published in the October 1886 number of *The Journal of The American Medical Sciences*, just 69 years ago. Thus by the careful, intelligent study of a pathologist-clinician, lesions of the appendix were transferred for the first time to the realm of surgery where they have remained. Beyond any question of a doubt this contribution of Fitz did more than that of any other in the long story of the disease, and perhaps more than those of all others combined, to demonstrate the exact status of the diseased vermiform appendix. Once and for all Fitz proved that the infection arose primarily in the appendix and that such former terms as typhlitis, perityphlitis, and paratyphlitis should be thrown aside. Confusion gave way to order. Appendicitis truly might have been called "*Fitz' disease*".

During our study of appendicitis we were less interested in the collections of mortality statistics as observed in widely separated points reported by surgeons of varied experience and ability, than we were of its pathologic course and the methods of combating the disease. Many of these reported statistics represented no intelligent analysis, no discriminating interpretation between the "*clean*" cases and those already gangrenous or perforated appendices. When these were all grouped together, the findings were worthless. From 1925 to 1930 there was no consensus of opinion in regard to the death rate. Indeed, in that period the appendiceal mortality statistics were being challenged by those who were

TABLE I  
Mortality per 100,000 for 10 southern states

Year	Ken.	Va.	Tenn.	N. C.	S. C.	Ga.	Ala.	Miss.	La.	Fla.
1940	10.1	7.2	7.2	6.3	6.8		7.9	11.2	10.0	9.6
1941	8.3	5.6	6.1	6.3	6.0	6.1	8.8	9.7	8.8	7.8
1942	7.0	5.2	5.5	5.8	5.2	4.9	5.3	7.2	6.6	6.2
1943	7.2	4.5	5.0	4.5	4.7	4.6	6.6	7.6	6.8	6.6
1944	6.6	6.0	4.6	4.1	4.8	4.5	6.0	8.2	5.6	6.5
1945	4.7	5.4	3.8	4.6	4.1	4.4	5.9	5.5	5.0	5.3
1946	3.9	2.7	3.3	3.1	2.7	3.0	4.0	4.5	3.7	4.2
1947	3.7	2.9	3.0	2.6	2.9	3.5	3.5	3.1	2.9	4.5
1948	2.7	2.2	2.5	2.4	2.1	2.0	2.8	3.6	2.9	3.2
1949	3.2	2.1	2.2	2.0	2.4	2.6	3.0	2.6	2.3	2.5
1950	1.8	2.0	1.7	1.9	2.3	2.1	2.0	2.6	1.9	2.0
1951	1.7	1.5	1.9	1.5	1.3	1.7	1.6	1.9	1.7	2.0
1952	1.6	1.8	1.6	1.2	1.6	1.8	1.3	1.7	1.1	2.0

attempting to prove that the death rate not only was not improving but actually was increasing. It appears that this was the peak period. Murphy had been hammering away for 10 years saying: "The average hospital mortality is a little over 10 per cent; there is no excuse for this; the rate is simply shocking". A decade later there was noted a decreasing mortality rate in appendicitis and by 1946 a marked decline in the United States. A spectacular drop in the death rate came in 1949 to 1950, both from the large hospitals and the smaller institutions as well. The question, of course, arose as to the cause of the drop. Was it better diagnosis, better surgery, or drugs?

One of us (A. W., Jr.) came upon the scene in 1941. Here is presented the prevailing ideas, opinions and actual mortality statistics existing at that time and those recorded within the past 15 years. By 1941 the death rate from all types of acute appendicitis had been reduced, on the average, for the 10 Southern States to 7.6 per 100,000. North Carolina alone in 1928 had a death rate of 10.7 per 100,000 while the United States as a whole recorded 13 per 100,000. The accompanying table (table I) shows the different states from which the records from the Departments of Vital Statistics had been obtained. There is no differentiation from ruptured appendicitis and simple acute appendicitis, but as is well known, these mortality figures on the whole represent the results of the treatment of *ruptured* appendicitis. This table shows a gradual decline throughout the years in every state. Intestinal intubation, control of dehydration and electrolyte balance, plus the use of whole blood when indicated, is reflected in the mortality rates. Further, the timing of the operation has done much to cause this decline.

In 1941 Thompson and his co-workers introduced the idea of local implantation of sulfanilamide crystals in ruptured appendicitis with peritonitis. The popularity of this technic was short lived because its complications outweighed the advantages of systemic administration of the sulfonamides. The use of chemotherapeutic agents further contributed to the decline until 1946 when the average was 3.5 for these Southern states. By 1946, after World War II, adequate



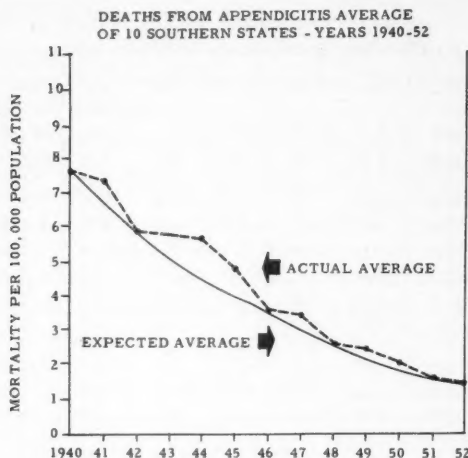


Fig. 1

medical and surgical care again was available to the majority of our population and the antibiotics began to come to the fore in the treatment of infections. By 1952 the death rates for the 10 Southeastern states stood at an average of 1.6 per 100,000.

The accompanying graph (fig. 1) shows the gradual decline in the mortality rate of these Southern states. The actual averages are shown by the broken line with not much change during the war years. From 1946 to 1949 there is a precipitous drop as shown by the broken line and from 1949 to 1952 the actual average approximates the expected average which is shown by the solid line.

This graph shows the improvement that has been made in the treatment of appendicitis. We believe that there is great danger of an over optimistic attitude because of antibiotics and that appendicitis as a disease will be considered as under control through the use of these agents. It is being said more and more by members of the medical profession that there is no danger in acute appendicitis because the antibiotics protect the patient from the dreaded complications. This decrease in over-all mortality rate through the years has been due to increased early diagnosis, public health measures, and above all education of the doctor as well as the patient. Unless this present trend is halted the medical professions' attitude toward the disease will be passed on to the laymen and there will be a definite rise in the death rate. Blalock and Nanson reported: "The present status cannot be viewed with equanimity. There are still many deaths from appendicitis; for example, in Great Britain alone some 1500 people die per annum from this disease". A questionnaire to all the professors of surgery in these same 10 states reveals that there is a great diversity among the teaching institutions as to the time and emphasis spent on this subject.

Cantrell and Stafford show that one-third of their patients in the Johns Hopkins Hospital with perforations of the appendix were seen by a physician 24

or more hours prior to operation; and more than 20 per cent of these patients were seen 48 hours or more preoperatively. They further emphasize that a figure of 20 to 25 per cent of normal appendices in patients with a preoperative diagnosis of acute appendicitis "*should not be looked upon as an unreasonable figure, but as a necessary evil*". They stress that a significant percentage of these patients were proved to have other acute surgical conditions, which would not have been discovered had the operation not been done.

The upward trend of improving the standards of all hospitals throughout the country in the appointment of Tissue Committees has been a great step in the formation of discipline within our ranks. However, the old adage, "it is better to take out 100 normal appendices than to let 1 perforate", must stand uppermost lest each surgeon consider his individual diagnosis-average too seriously in his attack on this disease.

#### CONCLUSIONS

In conclusion, we rejoice in the gradual improvement of the mortality rate in appendicitis, no matter what factor or factors have brought it about; we can give equal credit to the specific medication employed and to excellent modern surgical methods, but most of all the drop in the death rate began with the enlightenment of the laity, warning them against the double dangers of procrastination and purgatives. Let us still insist upon the assertion that appendicitis is a specific disease with its definite pathology and symptomatology; it is a continuing process—a going concern and that none of us will be satisfied until we have saved the one-hundredth patient.

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## THE TREATMENT OF CARDIAC ARREST\*

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"If one may define cardiac arrest as the cessation of cardiac activity in the absence of any basic cardiac abnormality, then this abnormal catastrophe should be considered as a rarity." In considering cases of cardiac arrest, one should not include that group of individuals, who, although they may die during an anesthetic period, do not die from causes that are basically unrelated to the anesthetic or operative procedure. A patient who dies of unexpected myocardial infarction or cerebral emboli, does not necessarily die of cardiac arrest. Accidents that may occur in the operating room, such as obstruction to the airway, overdosage of the anesthetic agent, and sudden uncontrollable hemorrhage, cannot be laid to the cause of cardiac arrest. As Potts<sup>12</sup> has stated, "A normal heart, fed by a sufficient stream of well oxygenated blood and not poisoned by excessive drugs, will not stop during any reasonable operation." Although this may tend to make one think that cardiac arrest is due to unexplained causes, we believe that most of these deaths are the results of mismanagement of the anesthetic agent and inadequate exchange of gases in the patient's lungs, or a combination of the two. Although we should be quick in praising the anesthetist, who has many cases to his credit without an incident of cardiac arrest, it is necessary also to lay the blame of many of these catastrophes at his door. The surgeon also should accept his due responsibility and not direct the well trained anesthetist as to how much, how long and by what method a given anesthetic is to be used. He should not continually insist on deeper anesthesia for relaxation at the risk of bringing the patient into the realm of one of these catastrophes.

In reviewing reported cases of cardiac arrest, one is impressed with the fact that 86 per cent of them occur during the operating period. The most dangerous times are those of induction and wakening. It is during these stages that fully 60 per cent of the cardiac arrests occur. It probably is during this time that the anesthetists, as well as the surgeons, are at the period of greatest laxity. This dangerous period should be attended by the greatest care on the part of the anesthetist and the surgeon.

Many believe that the incidence of cardiac arrest is on the increase. Perhaps with the development of more technics for cardiovascular surgery; with the advancement of extensive surgery in the carcinoma patients, and many newer technics of anesthesia, this is to be expected. In 1915, Kurlt<sup>5</sup> estimated that 1 patient in each 2000 anesthetized with chloroform died, while the death rate from ether anesthesia was 1 in 5000. In 1950, Laehy<sup>8</sup> stated that the expectancy of death during operation and anesthesia from all causes was 1 in 1000. Stephen-

\* From case records and operating room data of the general hospitals in the Atlanta area. Animal work from the Lawson Veterans Administration Hospital, Chamblee, Georgia. Presented during the Atlanta assembly of The Southeastern Surgical Congress, Feb. 21-24, 1955.

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son<sup>13</sup>, in a study from 30 large medical centers, recorded the incidence of cardiac arrest as 1 in 2384 anesthetics. Johnson and Kirby<sup>7</sup> recorded the incidence as 1 in 3600 anesthetics. If they eliminated those relative to cardiac surgery, there was an incidence of 1 in 6000. The potential danger to the patient undergoing surgery is real, and apparently there is little difference in the highly specialized medical centers than in the general hospitals. The incidence approximately is the same in all hospitals studied in this area. One important factor is that the incidence of recovery varies considerably in the hospitals. Those hospitals having a well organized resident program and doing considerable teaching apparently have the best recovery rates.

Cardiac arrest is by no means a subject that has been considered only in the light of modern day medicine. According to Boneau,<sup>1</sup> Schiff proposed, in 1874, to open the chest and restore spontaneous action of the heart by rhythmical compression of the ventricles. But it was not until 1892, that surgeons conceived the idea of applying so-called massage to the heart for the resuscitation of patients who die from chloroform. Neahaus, in 1889, first attempted to resuscitate the human heart by manual massage. This attempt was unsuccessful. The first successful case of cardiac resuscitation was reported by Haire and Martin<sup>6</sup> in the *Therapeutic Gazette*. They stated that Igelsrud, while doing an abdominal hysterectomy under chloroform anesthesia, had a sudden cardiac arrest, and massaged the heart through the thoracic approach. The result was complete resuscitation and the patient was discharged two weeks later.

The recognition of the effect of electric shock on defibrillating the heart is attributed to Prevost and Battelle<sup>9</sup> in 1899. This still is the best method for cardiac defibrillation. Since that time numerous reports have occurred in the literature showing some improvement as time went on. In 1906, Greene<sup>4</sup> reported a synopsis of 40 cases in which there were 9 successful cases, giving a recovery rate of approximately 22 per cent. It is interesting to note that almost 50 years later, Stephenson<sup>3</sup> in a report of 1200 cases, found successful resuscitation in only 28 per cent. Our present series of 50 cases shows a successful survival rate of 34 per cent. In almost 50 years, we have improved the results of this catastrophe by little more than 10 per cent. In spite of the research work, and the volumes of writing that one finds in the literature, there still is an appalling number of deaths from cardiac arrests that are potential survivors. Glenn<sup>3</sup> estimated that 10,000,000 operations are done in the operating rooms of the United States throughout the year, so a reasonable estimate of the incidence of cardiac arrest during operation would be approximately 5000. We, at the present time, are not saving half of these patients. One must, therefore, sit down and take stock of the methods of prevention of this catastrophe and consider the reasons why more of the patients are not being resuscitated.

Let us consider briefly some of the known causes of cardiac arrest. In all articles reviewed, as well as in our own experience, hypoxia is listed as the major cause of cardiac arrest. The importance of this is shown by the fact that 16 of our patients were noted to have hypoxia on a clinical basis before cardiac arrest occurred. If hypoxia occurs during anesthesia, one should not hurry through the

operation in order to get through before the patient's heart stops beating. He should stop immediately and find the cause of the hypoxia and allow the anesthetist to oxygenate the patient. After all, the idea of getting the patient back to the room before he dies is rather stupid. If a patient must die, the best place he can do it is in the operating room. Here he has the best chance of resuscitation.

Much has been said recently of the role of hypercapnea as a factor in the pathogenesis of cardiac arrest. Sealy, Young and Harris<sup>11</sup> stated that studies of the electrolyte metabolism in hypercapnic rats and dogs revealed a constant increase in plasma potassium concentration. This hyperkalemia increases and is most marked during the posthypercapnic period. It has been suggested that the changes in plasma potassium associated with complex metabolic disturbances in the heart are important in the development of the so-called posthypercapnic cardiac arrhythmias. Certainly we have seen cardiac arrest in the patient in whom there was no evidence of hypoxia or other causes. Here hypercapnea was thought to be the major factor. Clowes<sup>10</sup> also believed that there were definite warning signs of so-called posthypercapnic ventricular fibrillation noted on the electrocardiogram. He thought that these signs could be changed by the intravenous injection of 20 per cent glucose and 3 per cent sodium chloride solution. From all of the evidence present, one must consider that hypercapnea is a potential source of cardiac arrest and ventricular fibrillation. Swann<sup>11</sup> has shown that, although potassium chloride was of no value in preventing fibrillation, once the heart had fibrillated, the potassium chloride was a definite aid in defibrillating the heart. He believes that during fibrillation, potassium is lost from the myocardium. Others have suggested that this loss may be due to muscle anoxemia and may not have a part in the actual production of the fibrillation. Hypercapnea can be prevented by adequate ventilation on the part of the anesthetist.

Much has been said in regard to reflex vagotonia as a cause of cardiac arrest. Reid, Stephenson and Hinton<sup>10</sup> believed that the cardiac tissue has the capacity to originate stimuli. They thought that the ability of the myocardium to generate these stimuli was hindered by anesthesia, and therefore, would become vulnerable to the vagal reflexes. Anoxia, itself, will not cause these reflexes, but its presence certainly potentiates the reflex action. Procedures that produce stimuli of the vagus nerve may not be carried through without danger to the patient. Therefore, any of these procedures that are contemplated, should be well covered by the previous use of atropine. The usual method by which atropine is given is strongly condemned. The patient may receive .5 mg. from one to two hours before the actual danger period has been reached. It would be better if the anesthetist used the atropine directly in the vein at the time of induction of the anesthetic. As this action wears off, further dosage should be given throughout the operative procedure. Turk and Glenn<sup>14</sup> have shown that direct stimulation of its branches during operation may initiate bradycardia and cardiac arrest.

The possibility of drug sensitivity or poisoning always must be kept in mind when various combinations of agents are being used. Certainly when cardiac arrest occurs secondary to the use of topical anesthetic, such as cocaine and pontocaine, attempt at resuscitation may save a life.

Such factors as drug poisoning, hemorrhage, fatigue, or traction on the heart itself, may in the presence of some of the above mentioned factors, play a contributing part.

If one is to be successful in resuscitating patients with cardiac arrest, there must be considerable background of thought, as well as experience on the operator's part. The anesthetist always must be aware of the potential occurrence of this catastrophe and be in the position of always knowing the condition of his patient. The operator can be of inestimable help to the anesthetist by noting the color of the blood, the blood flow, and the color of the tissues. If he is operating in the chest, he always should keep one eye on the cardiac action and the other on the operative field. In all major surgery, when prolonged anesthesia is contemplated, when considerable trauma is to occur, or when other factors may lend themselves to cardiac irregularities, an electrocardiogram is of extreme importance both to the anesthetist and the surgeon. We realize that all operating rooms cannot be equipped with the cardioscope, but at least those operations conducive to cardiac difficulties can be followed with the use of the regular electrocardiogram. Changes that may be of importance can be picked up first on the electrocardiogram. We realize there are many things that the anesthetist has to watch. The electrocardiograph may mean the margin of safety. In some areas, a constant recording oximeter is used.

Once the catastrophe of cardiac arrest has occurred, there must be immediate action on the part of all those concerned. The anesthetist should be the first one to recognize cardiac standstill, and, to quote Bailey<sup>2</sup> he should say to the surgeon, "The heart has stopped. Will you open the chest or shall I?" If the person who is opening the chest has not thought this out in the past and had the proper mental attitude, as well as the background in methods of resuscitation, he undoubtedly will fail. It is here that we would like to urge all hospitals and all teaching services to make cardiac resuscitation an actual course for their house staff. This should be the first thing that a new intern is taught before he goes on the ward or into the operating room. We believe that the major cause of failure is twofold: (1) Hesitancy on the part of the person concerned to carry out the necessary means for the resuscitation of a cardiac arrest, and (2) the inadequate application of cardiac resuscitation methods.

A simple experiment may be set up in the dog laboratory to demonstrate these facts. One may connect a large artery of a dog to a Sandborn recording cardiometer with a pressure recording device, and then institute ventricular fibrillation. One then may attempt cardiac massage. The untrained and inexperienced will be unable to constantly elevate the femoral pressure to a satisfactory level by his massage efforts. One can see, therefore, that the felony, having been committed, is now compounded by the inexperience of the operator. We believe that, although many of the chests are entered promptly and adequately, massage, because it is ineffective and inadequate, will allow the patient to progress to permanent cerebral damage and make resuscitation impossible. Figure 1 shows the tracings recorded from such an experiment. Note that the systolic beats were not only inadequate, but that little elevation of the diastolic pressure was

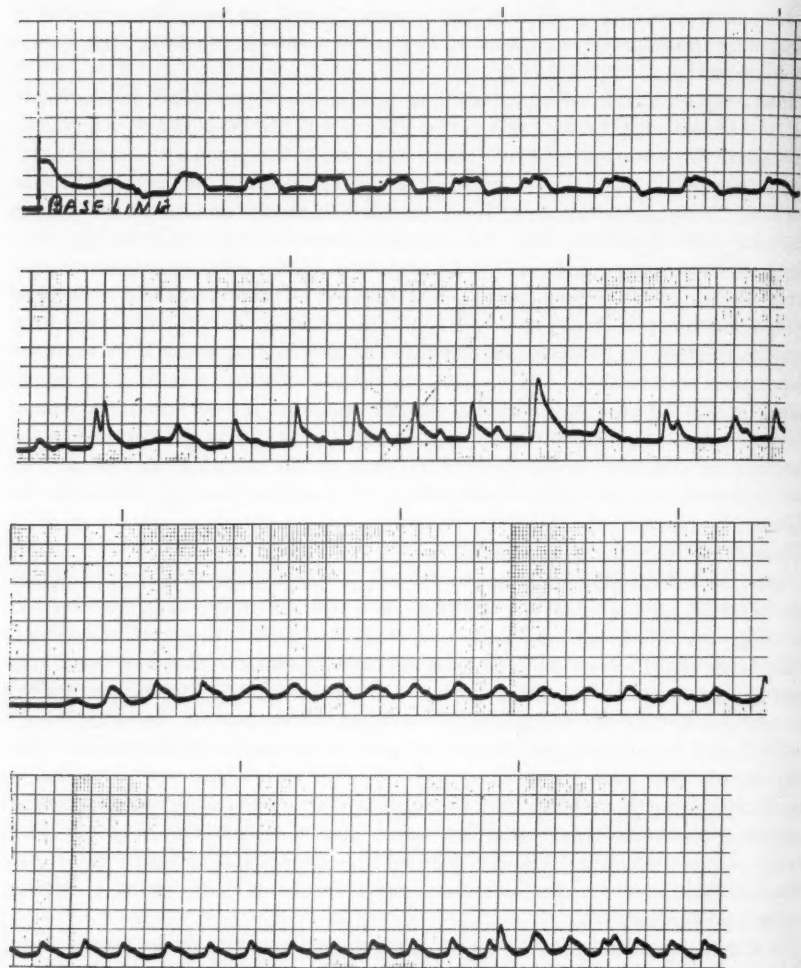


FIG. 1. Femoral artery tracings in a dog during cardiac massage. Note inadequate elevation of systolic pressure as well as low systolic peaks.

accomplished. Figure 2 shows the result by the same operators, after adequate instruction and a little experience. Note here effective systolic beats as well as elevation of the diastolic pressure. It also is well for the practicing physicians and surgeons who have not had experience with this abnormality to go into the laboratory and try it themselves. We believe that the reasons we have increased our survival rate by less than 10 per cent over a period of 50 years, is due to the fact that we have not adequately instructed the men who come in contact with the catastrophe.



FIG. 2. Femoral artery tracings in dog during cardiac massage. Note elevation of systolic pressure to normal levels. Systolic peaks are adequate to maintain normal blood flow.

In order to properly resuscitate the heart, there is a minimum of equipment that is necessary. One might say, "All I need is a knife." This indeed is not true, because a knife will open the chest, but it will not provide an airway. The ideal airway is an endotracheal tube with an anesthetist on the other end ventilating the lungs. The second best method is with a face mask and an airway. The third best would be mouth to mouth resuscitation. If one opens the chest for a brief period of time, adequate ventilation of the contralateral lung can be obtained by gentle traction and relaxation on the hilus of the lung. Certainly all modern hospitals and operating rooms should be equipped with a cardiac resuscitation cart (fig. 3). This cart should be adequate and complete in its equipment. In each operating room there should be a knife so that one can open the chest at a moment's notice. The pack containing the knife should be designated in a special color or in a special place, so that it may be found without delay. All roentgenologic departments should have adequate equipment for the resuscitation of patients with cardiac arrest, and it goes without saying that the recovery room—one of the most vulnerable spots other than the operating room—should have all basic equipment necessary. Each ward of the hospital also should be equipped with basic necessities for resuscitation of cardiac arrest. The more complete mobile cart can be kept in the operating room until needed.

If one does not have access to the necessary equipment to successfully carry out resuscitation, it should not be attempted. The attempt to carry out heroics on the side of a road or by a lake is to be condemned. One also hastens to urge that we do not try to bring back those people who obviously have been dead much longer than the brain can tolerate. To see human beings become merely vegetables is much worse than death. If success is anticipated, the time interval between cessation of circulation and massage cannot be longer than 4 to 6 minutes. The chest must be opened rapidly at about the fourth innerspace,





FIG. 3. Cardiac resuscitation cart

the heart must be massaged at a rate of 60 to 80 times a minute. An adequate airway must be established and oxygen given at once. After these measures are instituted, one can then relax and maintain adequate massage, while determining exactly what the situation is. Some have feared opening the chest and finding a heart that still is beating. One must assume cardiac arrest if no blood pressure is obtainable, if no pulse is felt and if no heart sounds are heard. It is far better to open a chest and find a feebly beating heart which is maintaining no effective circulation than to allow a few minutes to elapse unnecessarily in a patient who has cardiac standstill.

After massage is instituted, one then must determine whether the heart is in standstill or in ventricular fibrillation. In either event, after adequate incision in the chest is obtained, and one is able to massage the heart, the need for rush is now at an end. One can maintain adequate massage for an indefinite period of time. In our experience, we have known massage to be continued for  $2\frac{1}{2}$  hours, with complete recovery. We now must call for more help, including an adequate cardiac resuscitation try with the necessary drugs and other equipment. If we are not certain whether ventricular fibrillation is present or not, an electrocardiogram is taken. This will give an adequate idea of the status of the myocardium. If it is determined that the patient is in arrest, and he does not pick up spontaneous beats within a few minutes of massage, one may inject into the chamber of the left ventricle a solution of adrenalin chloride. Let us emphasize here that all injections into the heart are made directly into the chamber of the left ventricle, for it is the coronary circulation that we wish to perfuse. The injections are not made into the wall of the ventricle. We have used approximately 1 cc. of a solution made up by mixing 1 cc. of 1 to 1,000 solution of adrenalin, with 5 cc. of

normal saline. After the initial injection, if adequate cardiac beats are not picked up, one then may use a solution of calcium chloride, 10 per cent, 2 to 4 cc., injected into the cavity of the left ventricle and then continue the massage. We believe that anyone who has had cardiac arrest, should have atropine in adequate dosage to overcome any possible vagal effect. If after 5 to 10 minutes, no response is obtained, one may repeat the procedure. If this is done more often, ventricular fibrillation may ensue.

Ventricular fibrillation is diagnosed by totally unrelated twitching and convulsions of the ventricular myocardium. If one is not certain of this, the electrocardiogram will give the correct answer. Certainly if ventricular fibrillation is present, the introduction of either adrenalin or calcium chloride may make the defibrillation process almost impossible. It is for this reason that we condemn the use of adrenalin through the chest wall in an attempt to resuscitate the heart. One cannot tell from the outside if ventricular fibrillation is present unless the patient is attached to an electrocardiograph. After one determines that ventricular fibrillation is present, complete oxygenation of the cardiac musculature must be attempted by adequate ventilation of the lungs and adequate cardiac massage. The best method available for the defibrillation of the heart at the present time is the electric shock method (fig. 4). With the use of many of the commercial defibrillators, one can obtain an adequate electric shock to the myocardium which will reduce ventricular fibrillation. It has been our experience that, in order to completely defibrillate the heart, one must bring the electrodes as close together as possible by compressing the heart between them. Sometimes a series of short timed shocks is more effective in defibrillating the heart than one single shock. Adequate insulating of the electrodes to prevent burning

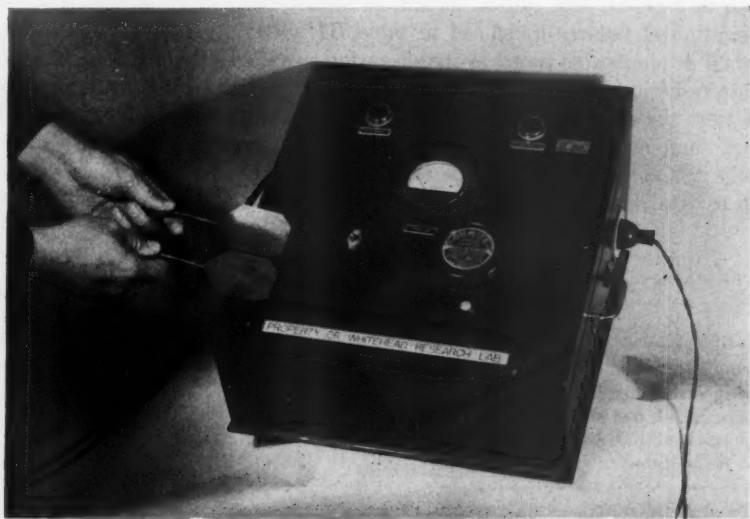


FIG. 4. Electric defibrillator. This type may be made in any electrical laboratory.

of the cardiac musculature is necessary. After ventricular fibrillation has been stopped, the heart is in standstill, and methods for resuscitating the standstill now can be brought into use. In ventricular fibrillation, a shock of 140 to 220 volts and from 3 to 5 amperes should be used.

There are additional things that may be of benefit to the individual attempting to resuscitate the heart. For instance, some have suggested that the aorta be clamped just distal to the subclavian in order that all of the circulation may be directed toward the more sensitive brain. This has not been necessary in the patients that we have attempted to resuscitate. If one thinks that drugs are not adequately entering the myocardium, a clamp can be placed across the ascending aorta as the heart is massaged. This directs the flow directly into the coronary circulation. The pericardium should be opened whenever the heart must be defibrillated and may be opened anytime one thinks that he may obtain better massage. Transfusions often are necessary to bring about an adequate blood volume.

#### DISCUSSION

We have reviewed 50 cases of cardiac arrest over a period of 2 years. These have been seen in 8 hospitals in the Atlanta area. Of these 50 patients, 17 are living and well, (table I), 2 are living, but have evidence of cerebral damage, 1, a child, is a complete vegetable, 5 months after the arrest. Two were completely resuscitated and must be considered as successful as regards their cardiac resuscitation, but later died of other causes. Eighteen patients were successfully resuscitated as far as the heart was concerned, but died from obvious cerebral damage. Eleven patients were not resuscitated.

The causes of cardiac arrest as found by detailed analysis of these cases, are listed in table II. The causes for failure already have been touched upon. Our estimation of failures is defined in table III. Certainly delay in resuscitation beyond 4 minutes, as timed in the operating room, was the major cause of failure to resuscitate. In 6 other cases, we believe that inadequate means and methods were the causes of failure. It is seen that, in addition to the 19 successful cases, there should have been 16 more successful ones added to this list. Certainly it is not too much to hope that with better training, more careful attention to details, that not only the prevention of this catastrophe may be a factor

TABLE I  
*Results of resuscitation efforts in 50 patients*

	Number
Living and well.....	17
Living with central nervous system disease.....	2
Resuscitated, but died from other causes.....	2
Resuscitated, but died from central nervous system complications.....	18
Not resuscitated.....	11
Total.....	50

TABLE II

*Causes of cardiac arrest and results of resuscitation*

Cause	No.	Resuscitated and Living	Resuscitated but Died	Not Resuscitated
Hypoxia.....	16	9	5	2
Drug reaction.....	5	2	3	0
Cardiac failure.....	5	0	0	5
Vomiting and aspiration.....	4	1	3	0
Cardiac manipulation.....	2	2	0	0
Laryngospasm.....	2	1	0	1
Bronchospasm.....	2	1	0	1
Hemorrhage.....	1	0	1	0
Air embolism.....	1	1	0	0
Unknown.....	12	2	8	2
Total.....	50	19	20	11

TABLE III

*Causes for failure to resuscitate 29 patients*

Delay in resuscitation.....	12
Inadequate methods.....	6
Complicated by associated conditions.....	3
Heart failure.....	5
Unknown.....	3

in the future, but also that once it has occurred, it is not too much to hope for a 50 per cent survival rate.

## IF CARDIAC ARREST OCCURS

1. Open chest at once. One has only 2 to 5 minutes.
2. Begin massage—60 to 80 times per minute.
3. Establish airway and give oxygen.
4. Get help. One must have relief if adequate massage is to be continued.
5. If standstill is present:
  - a. Massage
  - b. Inject Adrenalin—1 cc. of dilute solution.
  - c. Inject calcium chloride—3 cc. of 10 per cent solution.  
(Note: All injections into chamber of left ventricle.)
  - d. Repeat above every 5 to 10 minutes.
  - e. Give Atropine in large doses.
6. If fibrillation is present:
  - a. Massage
  - b. Use electric defibrillator
  - c. Drugs may be helpful but doubtful
    - (1) Novocain
    - (2) Pronestyl

## SUMMARY AND CONCLUSIONS

We have presented 50 cases of cardiac arrest. We believe that, in the majority of the cases, the cause was hypoxia. Prevention still is the best method of therapy and certainly the incidence may be reduced if proper ventilation of the patient is carried out during anesthesia, regardless of type used. The surgeon should not push the anesthetist to obtain more relaxation than usually is necessary and thereby induce overdose of drugs.

We urge all interns to be adequately trained in cardiac resuscitation when they enter their hospital period. The necessity for experience in the methods of cardiac massage is important to prevent compounding a felony that already has been committed. Careful and judicious use of all agents that may produce hypersensitivity and drug poisoning always should be instituted. Atropine should be used with each anesthetic and not given an hour or two before the time needed.

We believe that anyone, regardless of his specialty, who is administering to the needs of a patient should be prepared to handle any catastrophe that may intervene. Therefore, medical man, radiologist, surgeon and anesthetist must have a knowledge of cardiac resuscitation. We condemn the attempts at resuscitation that may be done in places in which equipment is unobtainable for successful carrying through of the attempt.

Results to date do not justify the potentiality that exists, but we believe that with increased training, plus more adequate education, the survival rate of this catastrophe can be brought beyond the 50 per cent mark.

We would like to say here that we do not believe that we shall accept the latin proverb, "Nulla Pulsa, Nulla Therapia."

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## MULTIPLE CANCER: FOUR PRIMARY NEOPLASMS IN ONE PATIENT\*

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Multiple primary tumors have stimulated the interest of numerous observers<sup>1, 3, 4, 5, 7, 9, 10, 11, 12, 13</sup> since Billroth<sup>2</sup> first reported the occurrence of different primary malignant tumors in the same patient. Many of these are single case reports with brief reviews of the literature, but several have been careful reviews of the available literature and have included large numbers of new cases.<sup>3, 9, 11, 13</sup> The conclusions of most of these authors have been that there is a definitely increased incidence of multiple primary lesions as compared to the expected normal incidence of cancer in the general population. They further concluded that multiple malignancies in the same patient indicated a constitutional predisposition to cancer; therefore, a hereditary influence, or some as yet unknown reason why an individual who had had one cancer had an increased chance of developing a second one.

However, the figures were not analyzed carefully from a statistical standpoint according to Watson.<sup>14</sup> He recently has subjected this question to a critical statistical analysis and has tried to correct certain opinions and statistical methods which mitigate against accurate appraisal of the probability of second or multiple malignancies.

A large number of reports have described multiple lesions in the colon, and a large number of cancers of the skin and lip have been included, the last two seemingly most frequent in rural areas. One case report (Ettinger<sup>5</sup>) describes four separate primary carcinomas in the colon, one in the bladder, and one in the skin in one patient. Lund<sup>8</sup> definitely stated that a particular organ may be susceptible to cancer and, therefore, that there is a predisposition to malignant development in this organ. However, this should not be considered as an indication of a general predisposition to cancer.

In Watson's material from the City Hospital of Saskatoon, Canada, of 702 multiple cancers in the different organ systems, 534 were of the skin. In his tables, he stated that: "Most combinations of multiple cancers included cancer of either the skin or lip as one of the sites. The cure rate of cancer in these situations is well over 90 per cent. . . . These patients are exposed on the average to a long period of time during which they can develop another cancer following the first one."

Watson analyzed 1,171 patients who had a second malignancy in a series of 16,662 patients who had been observed at the Saskatoon Cancer Clinic. He then corrected for: (1) the age distribution of cancer patients compared with the normal population, (2) the fact that the life expectancy of a person who has had cancer is much less than that of a normal person of the same age, and he is, there-

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fore, available for observation for a shorter time, and (3) the small number of multiple cases occurring in one year. He then developed a statistical system to correct for these factors. When his final curve of the incidence of multiple cases (excluding multiple skin and lip cancer) was compared with the standard Dorn<sup>6</sup> figures for the incidence of cancer in the United States, the curves practically superimposed. Therefore: "the incidence of true multiple cancer (defined as two or more primary malignant tumors in different organs or systems) does not differ from the ordinary incidence of cancer in the normal population," and, according to Watson<sup>14</sup>: "There is no constitutional tendency to develop a second cancer or to develop an immunity following a first cancer."

Nevertheless, the incidence of three or more cancers is rare, even using Watson's criteria that they each must be in different organ systems, and that lip and skin cancers should be excluded. Watson found only 11 cases where there was a primary tumor in three systems among 1,171 cases of multiple cancers. Of these 11, 9 had carcinoma of the skin and lip (personal communication from the author<sup>15</sup>), so that in only 2 cases of the 1,171 multiple carcinomas were three separate organ systems involved other than lip and skin. These were: (Case A)

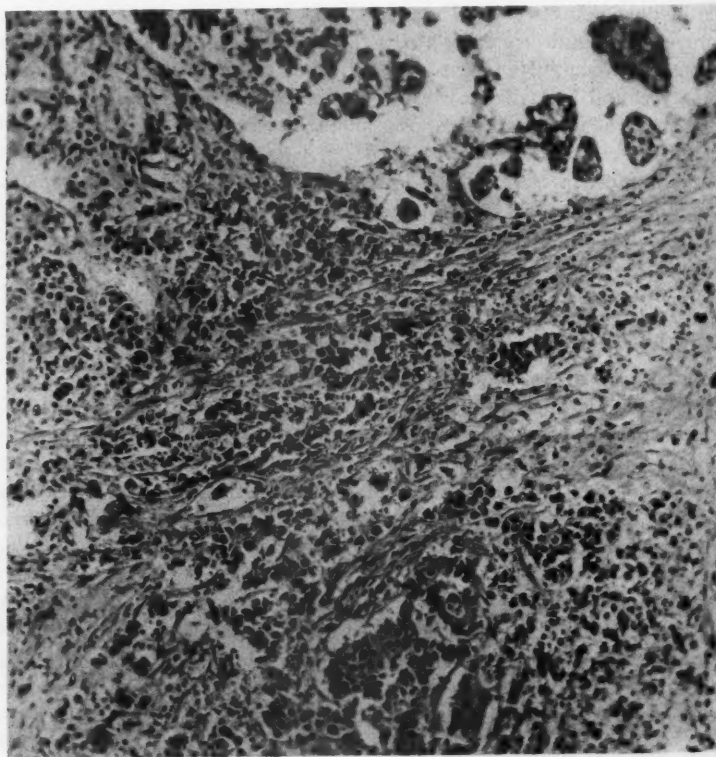


FIG. 1. Ulcerating adenocarcinoma of the colon invading muscle

osteogenic sarcoma, carcinoma of the lung and Hodgkin's disease; and (Case B) carcinoma of the stomach, myelogenous leukemia and carcinoma of the rectum.<sup>15</sup>

Goldstein and Rubin<sup>7</sup> of Sinai Hospital in Baltimore reported 1 case of a man who had four primary carcinomas: these were carcinoma of the sigmoid colon, hypernephroma, basal cell carcinoma of the skin, and transitional cell carcinoma of the bladder. They compiled a table of all the cases that they could find (11 in number) where four primary malignancies had been reported. Their article was published in January 1948, and 4 of these cases had been reported after 1944. There have been, undoubtedly, many similar cases reported since then which have not been readily available in the literature.

Our patient had two distinct carcinomas in the colon: a seminoma of the left testicle, and a lymphosarcoma from which he probably died. If Watson's criteria are followed, and multiple primaries in the same organ are excluded, this patient should be classified as having had three distinct primaries. In none of the reports before Watson's study have cases been so classified. However, in view of Watson's analysis, this evidently should be done.

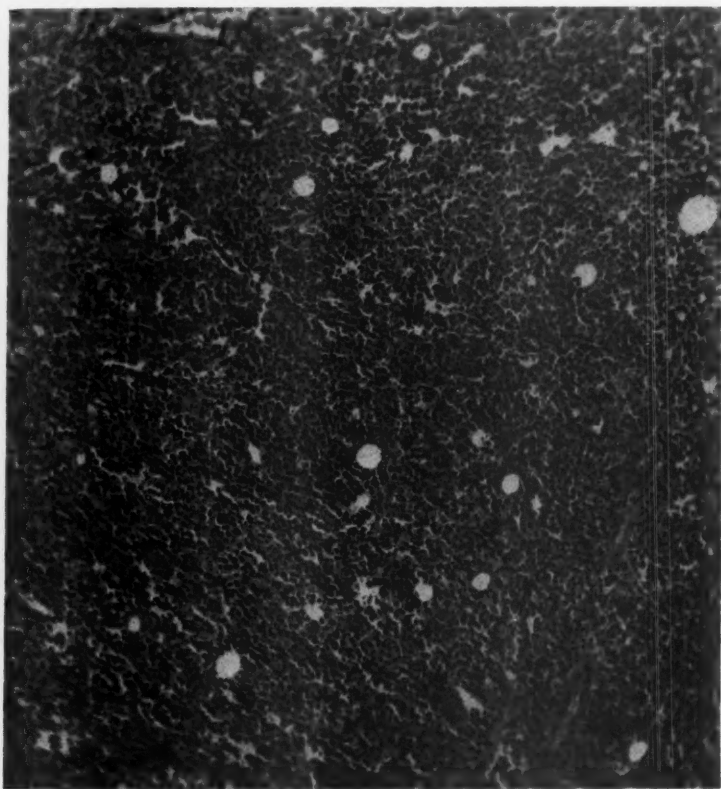


FIG. 2. Lymphosarcoma from the left axilla.

## CASE REPORT

H. W. (male), aged 59, was first seen on Nov. 7, 1952 for carcinoma of the sigmoid. He had a six month's history of increasing anorexia and constipation. There had been blood in his stool on one or two occasions and for the past month or two, he noted cramping abdominal pain which was relieved by bowel movement. There was some abdominal distention when he entered the hospital. At the operation on Nov. 10, 1952 (Harper Hospital): "A plum-sized mass was present in the proximal sigmoid just beyond the descending colon. Eight centimeters downward in the midsigmoid region was another mass, which was firm and was almost as large as the first one, with some involvement of the mesenteric nodes. The liver was free from metastasis." Forty centimeters of the sigmoid colon was resected with the accompanying mesentery, and an end to end anastomosis was made. The upper lesion was about 5 centimeters long, encircled the bowel, and infiltrated all muscle layers. The second lesion was about 5 centimeters in diameter and infiltrated the muscular coats (fig. 1). Both lesions had metastases in the adjacent mesenteric lymph nodes. Convalescence was uneventful.

The patient again entered the hospital (Sinai Hospital) on Jan. 19, 1954, complaining of pain and a mass in the left axilla. He attributed this mass to an automobile accident two weeks previously when he was struck in the left axilla with the steering wheel. He had been feeling somewhat weak and dizzy at times for the past several months. On January 21, an

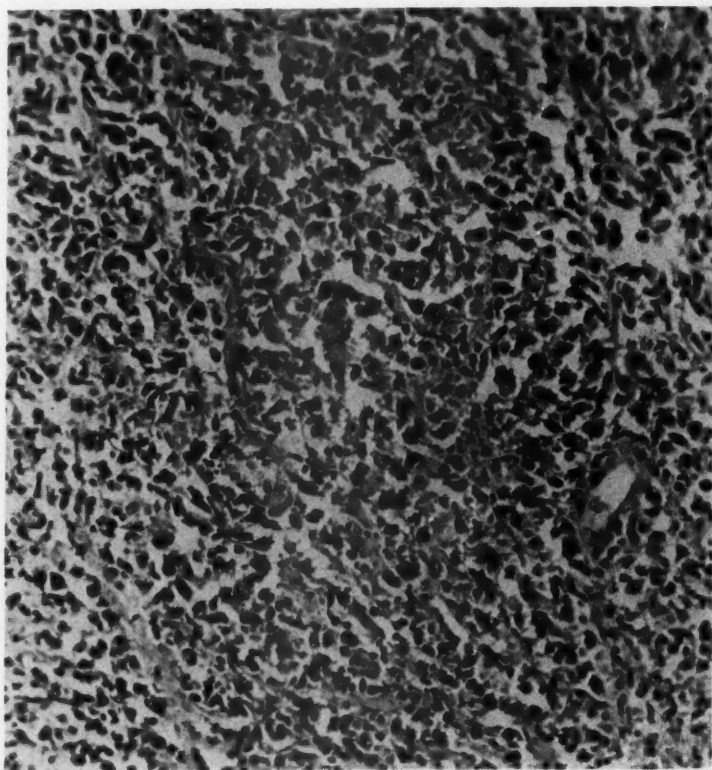


FIG. 3. Seminoma of the left testis

irregular, lobulated mass in the left axilla was resected. It measured 6 by 8 centimeters in size. The microscopic diagnosis was lymphosarcoma (fig. 2). Radiation therapy was given.

This patient had had a mass in the left testicle which had not been noticed before, but which he then told us had been present for two years. The testicle was symmetrically enlarged to about two and one half times the size of the opposite testicle. It was removed by Dr. Robert Cowen on February 12, 1954 at the Florence Crittenton Hospital. Through his courtesy, we have the pathologic report and the photomicrograph. It proved to be a seminoma (fig. 3).

The patient was readmitted to Sinai Hospital a third time on April 2, 1954. There were multiple complaints of weakness, anorexia, nagging, dull pain in the lower thoracic and lumbar spine, and occasional cramping pains in the epigastrium. There was no evidence of recurrence of the mass in the left axilla. There was now a large square, firm, nontender movable node, 2 by 2 centimeters in size, in the left inguinal region. The hemoglobin was 10.7 Gm, the white blood count was 5,350 per cu. cc. with 78 per cent polymorphonuclear leukocytes, and there was some hypochromasia on the stained smear. The left inguinal node on removal proved to be a lymphosarcoma, of the same microscopic picture as the previous left axillary node. He rapidly declined and died the thirtieth day after admission with hyperpyrexia and coma. Autopsy was refused. A roentgenogram showed some suggestion of a retro-peritoneal mass pressing upon the sigmoid colon. The previous sigmoid anastomosis seemed to be in good condition.

#### SUMMARY

A case is reported in which there were four primary malignancies: Two synchronous growths in the colon, a metachronous seminoma of the left testicle and generalized lymphosarcoma. The literature is reviewed. Watson's thesis that multiple malignancies in the same patient should be in different organ systems to be so classified, and that multiple malignancies of the skin and lip should be excluded, is concurred in. Using his criteria, multiple malignancies in the same patient indicate no predisposition to cancer.

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## SURGICAL TECHNIC

### CLOSURE OF INTERATRIAL SEPTAL DEFECTS BY OPEN CARDIOTOMY\*

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No problem has so taxed the ingenuity of the surgeon as have congenital malformations of the heart, and perhaps none of these has prompted greater inventiveness in the way of attempted repair than have interatrial septal defects. This anomaly, being relatively common and not overly complex, provides one of the more accessible opportunities for plastic procedures within the congenitally deformed heart. The methods so far devised for its correction truly are ingenious. Most of these technics have entailed an indirect or blind approach, but more recently Lewis and Taufic,<sup>29</sup> and Swan<sup>45</sup> have achieved direct visualization and obliteration of atrial septal defects by open cardiomy following inflow and outflow cardiac occlusion under hypothermic conditions. Although personally convinced of the superiority of the direct approach, there is no denying that a number of patients appear to have been cured and others greatly benefited by some of the indirect procedures depicted in figure 1. For that reason it would seem appropriate to review the evolution and clinical applicability not only of the direct method, with which this paper is primarily concerned, but also the various indirect attempts at closing an interatrial septal defect.

#### INDIRECT METHODS

In 1947 Cohn<sup>12</sup> showed that experimentally created atrial septal defects could be closed by invaginating the right atrial wall and suturing it to the septum so as to occlude the defect. The stalk of atrial wall thus created was then severed and the rent in the atrium closed with sutures (fig. 1). There is no evidence that this method per se was ever applied to the human being.

The following year Murray<sup>35</sup> reported clinical improvement in several patients following approximation of the anterior and posterior atrial walls alongside the septum by tying down blindly placed mattress sutures (fig. 1). Needless to say this approach is too inexact and offers no promise of complete obliteration of a septal defect. Also in 1949 Dodrill<sup>15</sup> reported the use of a specially designed ring-clamp for temporary apposition of the atrial walls thereby permitting a bloodless

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## INDIRECT CLOSURE OF INTERATRIAL SEPTAL DEFECTS

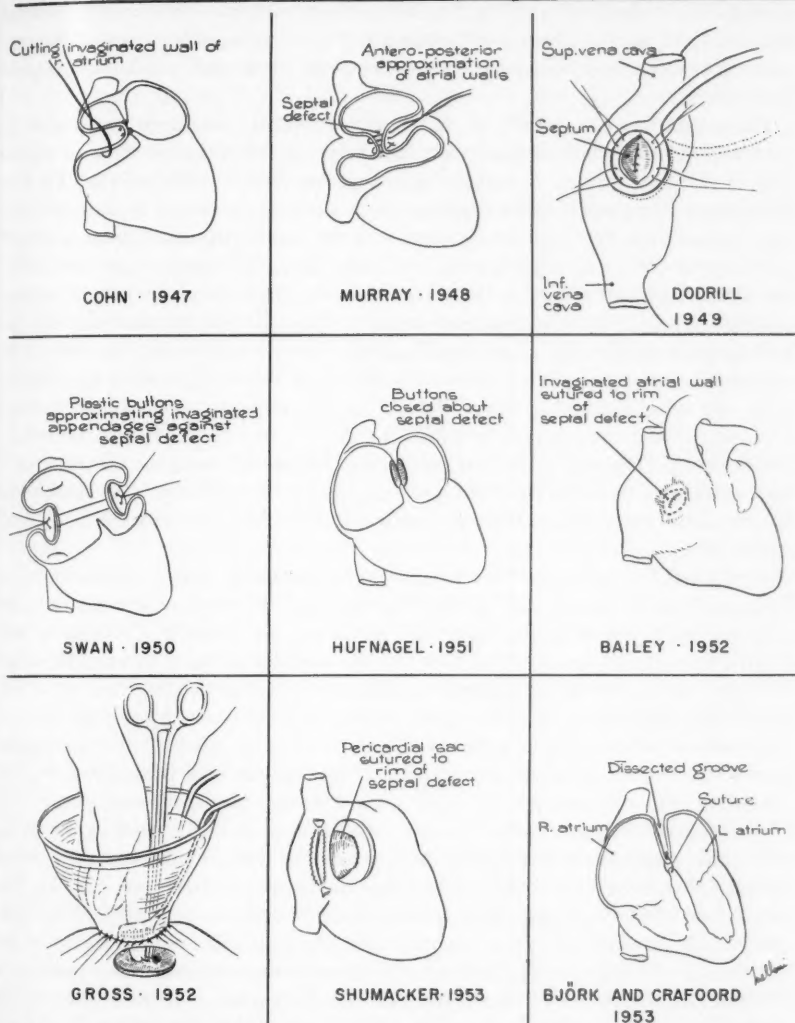


FIG. 1. Illustration of the many ingenious methods recently devised for the indirect or blind closure of interatrial septal defects.

approach to the defect (fig. 1). Since the operative area is severely restricted; since none but the small centrally placed defect can be exposed, and since serious arrhythmias and heart failure are said to attend the application of such a clamp,<sup>21</sup> it hardly can be considered practical.

In 1950 Swan's group<sup>46</sup> described a method of inverting both auricular append-

ages down to the septal defect upon two plastic buttons which when tied together tended to occlude the defect (fig. 1). This method has been abandoned for several reasons, chief among which are the hazard of obstructing the orifices of the pulmonary veins and encroachment on the size of the left atrium which is not dilated like the right.

Hufnagel<sup>27</sup> has successfully occluded experimentally produced septal defects by means of a cleverly devised instrument for applying plastic discs on either side of the septum and screwing them together over the defect (fig. 1). Unfortunately, congenital defects seldom have a complete rim of septum and for that reason these lucite buttons are apt to work loose with catastrophic results.<sup>21</sup>

Bailey<sup>1</sup> in 1952 described a technic of suturing an invaginated portion of the redundant right atrial wall to the rim of the defect (atrio-septo-pexy), thus completely occluding the defect but converting the dilated right atrium into a doughnut-shaped chamber (fig. 1). By modifying the basic technic he and his co-workers supposedly have been able to cope with several of the main problems connected with any blind method of septal defect closure, namely anomalous pulmonary drainage<sup>2, 38</sup> and the incomplete septal margin.<sup>2</sup> From a recent report the results by this method appear to be good,<sup>3</sup> but there is no questioning the advantages of direct suture of the defect and of preserving the atrium undistorted as is achieved by the direct approach, providing of course that it can be accomplished without undue risk.

Gross and his associates<sup>22</sup> have developed a distinctly unique approach via a large rubber well which, after being sutured to the right atrium, serves as a reservoir for the blood welling up after the atrial incision is made. Clotting is prevented by adding heparin to the blood in the well. By working through this pool of blood the defect can be palpated and closed by onlay plastic grafts or direct rim to rim suturing (fig. 1). That good results can be achieved by this method are attested by subsequent reports by Gross<sup>21, 23, 24</sup> and others.<sup>28, 34</sup> Once again, however, even though the results are good by this method, it stands to reason that they might be better still if done in a bloodless field under direct vision.

Shumacker<sup>41, 42</sup> has attached a pericardial pocket to an incision in the atrial wall with subsequent suturing of pericardium to the rim of the septal defect in much the same way as Bailey attaches the inverted atrial wall (fig. 1). The advantage of course is that there is less encroachment on the lumen of the right atrium, but in actual practice this may be more than offset by the tendency for dissolution of the pericardial pocket as Shumacker encountered in one patient.

Björk and Crafoord<sup>8, 9</sup> have applied still another method of closure (ascribed to Sondergard) entailing a dissection between the superior vena cava and right pulmonary veins until a groove is developed between the two atria. Then with a finger inserted through the right auricular appendage a suture is passed under digital guidance through the wall of the right atrium in close proximity to the aorta and immediately behind the right coronary artery. The needle then is passed subendocardially into the interventricular septum and brought out posteriorly between the inferior vena cava and inferior pulmonary vein. Thus the suture encircles the septal defect and by tying it down the defect is more or less

obliterated without encroaching on the vena cava, coronary sinus or tricuspid valve (fig. 1). Corroborative reports subsequently have appeared,<sup>17, 43</sup> but it is necessary to remember that the defects probably will be narrowed rather than completely sealed. From an analysis of these various closed or blind technics it becomes quite apparent that certain ones have merit. Several in fact have proved their value by successful clinical application.<sup>1, 8, 22</sup> Even so, each represents a compromise far from ideal and collectively they impose a serious handicap either in the form of greatly inadequate exposure or an exceedingly bloody operative field. Obviously the accurate and complete closure of any defect will be difficult under these circumstances and frankly hazardous when the defect is of the septum primum type. Moreover, indirect methods of suture not only entail inherent technical disadvantages but are attended as well by a significant operative risk. It was imperative, therefore, that a method be developed whereby the heart could be opened and plastic intracardiac repair carried out under direct vision in an uncramped bloodless field.

#### DIRECT METHODS

The ultimate goal in cardiac surgery is the perfection of a mechanical pump-oxygenator which will enable the heart to be bypassed while circulation is maintained and the blood oxygenated through an extracorporeal circuit. Gibbon<sup>18, 19, 31, 44</sup> has been primarily responsible for the early and current progress in this direction. In the laboratory artificially created atrial septal defects in dogs have been successfully closed by this technic.<sup>20, 32, 36, 37</sup> Nevertheless, because of the hazards still inherent in the use of the various mechanical devices so far developed, their clinical application remains severely limited. On both occasions where it has been attempted on the human being, the patient died.<sup>14, 25</sup> By a clever process of controlled cross circulation, involving a pump with a donor being utilized as the oxygenator, Lillehei<sup>51</sup> has been able to gain adequate time to close interventricular septal defects. On the whole, however, the use of the pump-oxygenator still is premature and not yet applicable to human beings.

Cessation of circulation by means of cardiac inflow occlusion has provided the final avenue of approach to this problem. After both venae cavae have been occluded and the heart has emptied, either atrium can be opened and the interior inspected with relative safety. This procedure has been known and utilized in the laboratory for many years but rarely applied to the human being. Undoubtedly, one of the chief deterrents to its human application is the fact that total inflow tract occlusion in the normal dog cannot be well tolerated in excess of 90 seconds. Swan<sup>47</sup> concluded that the risk was acceptable as a laboratory procedure for periods up to 4 minutes, but that thereafter the mortality rate climbs sharply. The entire basis for the recent display of enthusiasm for this approach stems from the remarkable effect of hypothermia in extending the safe period of cardiac inflow occlusion.

Hypothermia in one form or another has been utilized for the past 150 years. The historic aspects of the use of body cooling have been elaborately described elsewhere.<sup>52</sup> Current interest in hypothermia dates back only as far as 1950,

when Bigelow<sup>4, 5, 6</sup> published intriguing experimental proof of the relatively long period of circulatory arrest tolerated by the dog as a result of the reduced metabolism and decreased oxygen consumption during profound hypothermia. His group demonstrated that oxygen consumption fell in direct proportion to the decrement in body temperature. A similar fall in heart rate, arterial pressure and cardiac output also were noted. This group stressed the importance of controlling shivering and maintaining arterial oxygen saturation by artificial respiration. The main problem as emphasized by their studies was the high mortality rate due in most instances to ventricular fibrillation. It should be added, however, that Bigelow was working in excessively low temperature ranges around 20 C.

Seizing Bigelow's lead, Bailey's group<sup>13</sup> reported the use of hypothermia and cardiac inflow occlusion for repair of an atrial septal defect by open cardiectomy, but the patient developed ventricular fibrillation and died. The first successful closure of an interatrial septal defect was subsequently achieved by Lewis and Taufic<sup>29</sup> in September 1952, using cardiac inflow occlusion, hypothermia and the added factor of outflow occlusion to prevent air embolism. These workers more recently have presented a detailed report<sup>30</sup> of 8 atrial septal defects successfully closed out of 11 cases attempted. Swan and his group after their first report on atrial septal repair by a similar technic<sup>48</sup> have contributed a tremendous amount of experimental and clinical data on the application of this method<sup>10, 47, 48, 52</sup> and were instrumental in schooling us in the application of this technic. Their results have been most encouraging. In their series there has been but 1 death in 21 operations for an ostium secundum type of septal defect. In 18 patients the defects have been completely closed as evidenced by postoperative catheterization studies. In the other 2, both of whom had extremely large defects, there is a residual element of leakage according to postoperative cardiac catheterization attributed by Swan to the use of interrupted sutures. The picture has been quite different in their 4 operations for ostium primum defects, 2 of the patients having died, while the other 2 are not materially improved.<sup>49</sup>

Gratifying as the over-all results appear, the many problems common to the procedure are by no means solved. Without going into the tremendous volume of research currently in progress, it is pertinent to this report to mention certain physiologic considerations concerned with the prevention and treatment of ventricular fibrillation. Initially, of course, there was a natural tendency to blame hypoxia for ventricular fibrillation, but this has been shown to be unjustified.<sup>4, 16, 30</sup> More significant was the finding that extreme changes in the blood CO<sub>2</sub> level might play an important role in ventricular fibrillation.<sup>11, 38</sup> Working along this line, Swan<sup>48</sup> found that the CO<sub>2</sub> content of venous blood did not change appreciably throughout most of the procedure, but rose steeply 90 seconds after restoration of the circulation, evidence in other words that CO<sub>2</sub> had not ceased being eliminated during inflow occlusion but actually had accumulated in the tissues. This would be particularly true of heart muscle which continued to work throughout the period of cardiac occlusion. Under these circumstances the tissue pH necessarily drops to low levels. Immediately thereafter, however, arterial blood with a low CO<sub>2</sub> content perfuses the CO<sub>2</sub> laden heart, thus washing out CO<sub>2</sub>



and changing the pH from low to fairly normal levels within the space of a few heartbeats. This precipitous rise in the  $\text{CO}_2$  content of the blood can be attenuated by preliminary hyperventilation. By depleting the tissues of  $\text{CO}_2$  prior to inflow occlusion hyperventilation will prevent any excessive accumulation of  $\text{CO}_2$  during occlusion, thus reducing the fluctuation in serum  $\text{CO}_2$  levels and pH and decreasing the danger of ventricular fibrillation. By employing hyperventilation Swan's group reduced the incidence of ventricular fibrillation in the dog to about 8 per cent. Comparable evidence attesting the value of hyperventilation in preventing ventricular fibrillation has been presented by Scott and associates.<sup>40</sup> There remains little doubt, therefore, of the importance of hyperventilating these patients throughout both the cooling and operative period.

Another interesting aspect of Swan's work<sup>48</sup> was the fall in serum potassium accompanying hypothermia combined with hyperventilation. This coupled with the earlier demonstration by Hooker<sup>26</sup> of the ability of potassium to arrest electrically induced ventricular fibrillation in the dog, prompted Swan to use this ion as a chemical defibrillator. By injecting 2 cc. of KCl ( $\frac{1}{2}$  mEq. per cc.), into the proximal aorta and perfusing it through the coronary arteries by manual compression of the heart, he was able to induce cardiac arrest which then could be converted to a normal rhythm by the use of 0.1 cc. doses of a 2 per cent solution of  $\text{CaCl}_2$ . This has been a tremendous aid in defibrillating the cold heart. Lewis and co-workers<sup>30</sup> on the other hand have had no difficulty in converting ventricular fibrillation by electric shock and massage.

Additional experimentation in Swan's laboratory indicates that prostigmine potentiates the flow of potassium across the cell membrane and, when given directly into the coronary system immediately following outflow occlusion, this drug was effective in preventing ventricular fibrillation in 100 per cent of animals subjected to hypothermia and circulatory cessation.<sup>50</sup> In view of these studies we now routinely incorporate this prophylactic step in all open cardiomyotomies.

#### TECHNICAL ASPECTS

*Preparation.* In applying hypothermia we have adhered rather closely to Swan's technic.<sup>47</sup> A large vein is cannulated the night prior to operation. Anesthesia is induced with intravenous pentothal and maintained with ether after an endotracheal tube is inserted and connected to a closed anesthesia system. Electrocardiograph electrodes are attached to the extremities and a special direct writing thermometer is inserted into the rectum. Throughout the procedure blood loss is determined by gravimetric method and quantitatively replaced.

*Cooling.* When the third stage of anesthesia is reached, the patient is immersed in a tub of ice water, the temperature of which ranges from 2 to 4 C. Care should be exercised in keeping the head and neck above water. Henceforth the anesthesiologist must assiduously hyperventilate the patient. While the cardiologist pays close attention to the electrocardiogram, a member of the surgical team stands by, scrubbed and gowned, prepared to do an immediate thoracotomy should ventricular fibrillation or cardiac arrest supervene. Sufficient ether is administered to prevent shivering.

As a rule the rate of cooling parallels the size and adiposity of the patient.

When the rectal temperature reaches 31 C, a process taking anywhere from 15 to 90 minutes, the patient is transferred from the tub to a rubber mattress on the operating table. By this time hypothermia alone ordinarily provides adequate anesthesia, voluntary respirations usually cease, and the patient is maintained on nothing but 100 per cent oxygen. Following removal from the ice bath the temperature usually continues to drift downward another 3 to 4 C. Water of any desired temperature can be circulated through the mattress to assist in controlling the temperature. We consider 26–28 C the optimum degree of cooling for the repair of interatrial septal defects. In this temperature range the patients generally are pulseless and a blood pressure often is unobtainable.

*Operative procedure.* Surgical approach is by a bilateral transternal incision passing through the fourth intercostal space. The sternum is transected in notched fashion to facilitate a stable closure. The introduction of rib spreaders at the lateral margins of the incision affords excellent exposure of the heart, venae cavae, ascending aorta, pulmonary artery and lung roots. The superior vena cava is isolated proximal to the azygos vein and encircled with a heavy ligature. The intrapericardial portion of the inferior vena cava is similarly controlled (fig. 2). The pericardium then is opened widely, being careful to avoid injury to the phrenic nerves. At this point it probably is advisable to confirm the pre-operative diagnosis by making a digital examination of the interior of the heart through the right auricular appendage as advocated by Lewis, Varco and Taufic.<sup>20</sup>

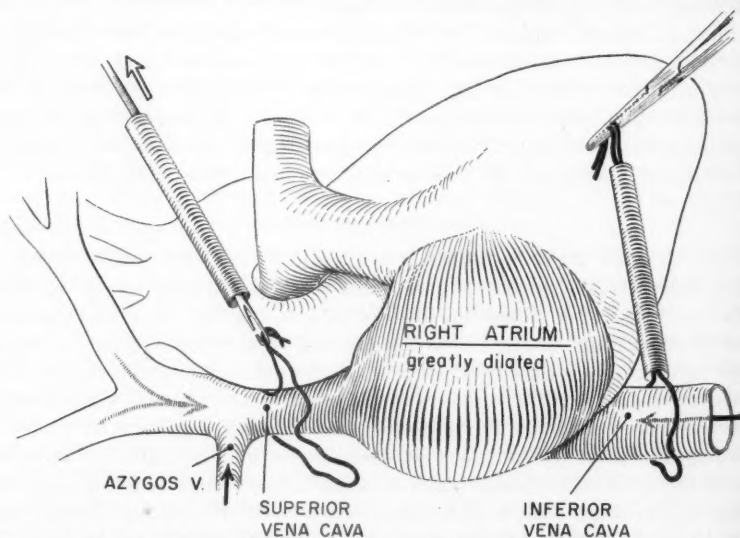


FIG. 2. This illustration of the heart and great vessels depicts the usual anatomic features encountered in interatrial septal defects emphasizing especially the enlarged right ventricle and greatly dilated right atrium. The inferior and the superior venae cavae have been encircled with heavy ligatures drawn through segments of rubber tubing preparatory to subsequent occlusion of venous flow into the right atrium. The azygos vein need not be separately ligated as long as the superior vena cava ligature is placed proximally.

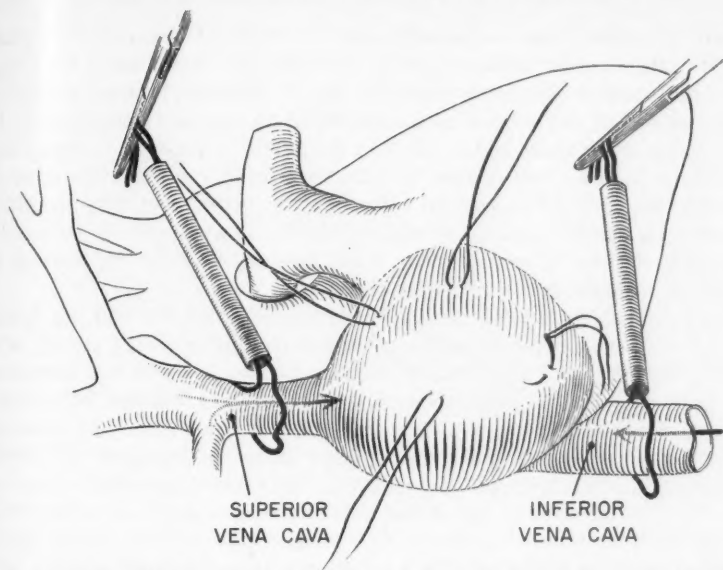


FIG. 3. This illustrates the placement of 4 traction sutures at opposite poles of the right atrium. Notice that the venae cavae remain wide open, the clamps serving merely to tag the caval ligatures.

To date we have not used this type of exploration, which might perhaps have obviated further intervention in 2 of our patients with an unsuspected atrio-ventricularis communis.

After planned but not prolonged deliberation 4 traction sutures are placed at opposite poles of the right atrium (fig. 3). A noncrushing clamp next is placed diagonally across the right atrium preferably a little posteriorly so as to gain ready access to the defect (fig. 4). The cardiac incision is made in essentially the same manner as shown in figure 5. The ligatures around the venae cavae are snugged down and the rubber tubes through which the ends of each ligature have been passed are clamped to maintain inflow occlusion. One must now wait 45 seconds in order to allow complete emptying of the heart.

Once empty, the heart becomes considerably smaller. A noncrushing clamp is applied to the aorta just distal to the aortic valves and prostigmine is injected into the proximal aorta whence it can be manually perfused through the coronary system for the purpose of preventing ventricular fibrillation (fig. 6). The aortic clamp then should be placed over the aorta and pulmonary artery together, being deliberately angled across the coronary ostia to preclude air embolism and as an incidental effect to prevent coronary sinus blood flow from obscuring the field. Clamping of the right and left pulmonary veins removes the final source of blood returning to the heart and by achieving complete inflow-outflow occlusion provides a completely dry operative field.

With measured haste the atrial clamp is removed and the atrial incision in

the slowly beating heart is opened widely by means of the previously placed traction sutures. After aspirating what blood remains in the heart, the interior of the heart can be adequately inspected (fig. 7). The size, position and type of defect, as well as any related anomalies should be accurately ascertained. The relationship of the atrial septal defect to the inferior vena cava, coronary sinus ostium and in case of an ostium primum its proximity to the atrioventricular node and the tricuspid and mitral valves must be determined. The presence or absence of anomalous pulmonary veins is likewise an extremely important consideration. If there be any question, it can be settled quickly by relaxing the clamp on the right pulmonary veins (fig. 8).

The interatrial septal defect is closed with interrupted No. 000 silk sutures. In view of Swan's experience with persistent leakage following closure of extremely large defects,<sup>49</sup> a running suture, as advocated by Lewis and associates,<sup>50</sup> may be preferable. When there is anomalous pulmonary drainage, care must be exercised that the sutures are placed to the right of these veins, lest pulmonary venous blood be deflected inadvertently into the newly delimited right atrium. Similarly, if one is not alert to the position of the valve of the inferior vena cava, it too can be rerouted to the wrong side of the reconstructed atrial septum. Despite such important considerations it is imperative that too much time not be lost in suturing the defect. We have arbitrarily chosen eight minutes as the maximum duration for inflow occlusion and would prefer to reestablish the cir-

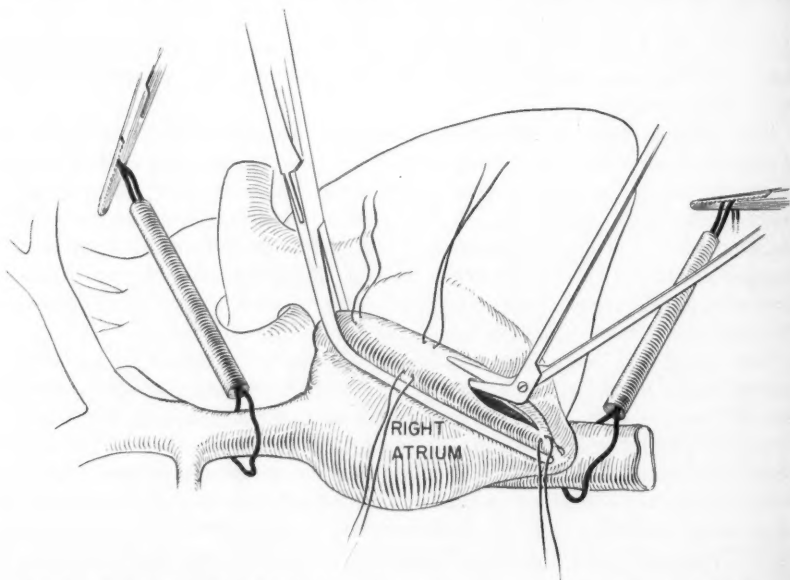


FIG. 4. After application of a noncrushing clamp across the right atrium an incision can be made in the manner illustrated without any blood loss. The clamp is applied diagonally and far posteriorly so as to afford easy access to the defect once the clamp is removed. The cavae are still open.

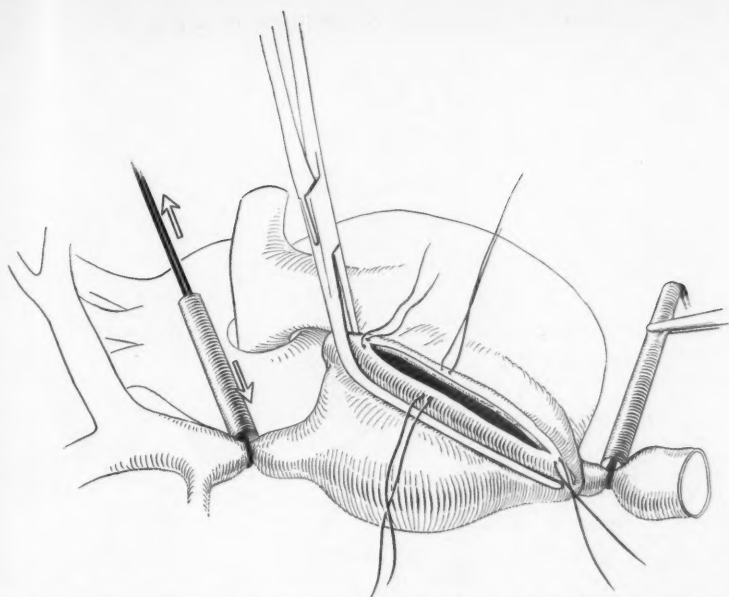


FIG. 5. Here the incision in the atrium has been completed. The ligature around the inferior vena cava has already been tightened down and the rubber tubing clamped so as to maintain occlusion. The ligature around the superior vena cava is in the process of being drawn taut and is about ready for clamping. Thus the entire venous return to the right atrium is shut off. Before proceeding further, approximately 45 seconds must be permitted to elapse in order to obtain complete emptying of the heart.

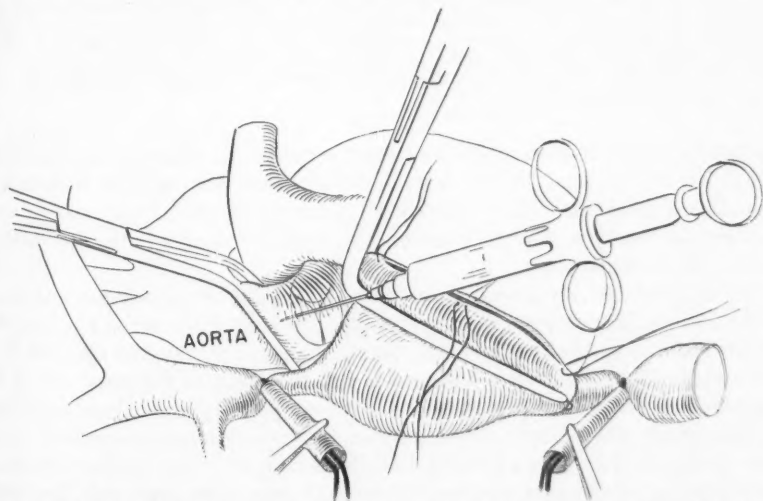


FIG. 6. Notice that as the heart has emptied, it has become greatly reduced in size. A noncrushing clamp has been placed across the aorta just distal to the aortic valves. As depicted in this drawing, prostigmine is injected into the aorta between the clamp and aortic valves and by massaging the heart this material is perfused through the coronary arterial system to assist in preventing ventricular fibrillation.



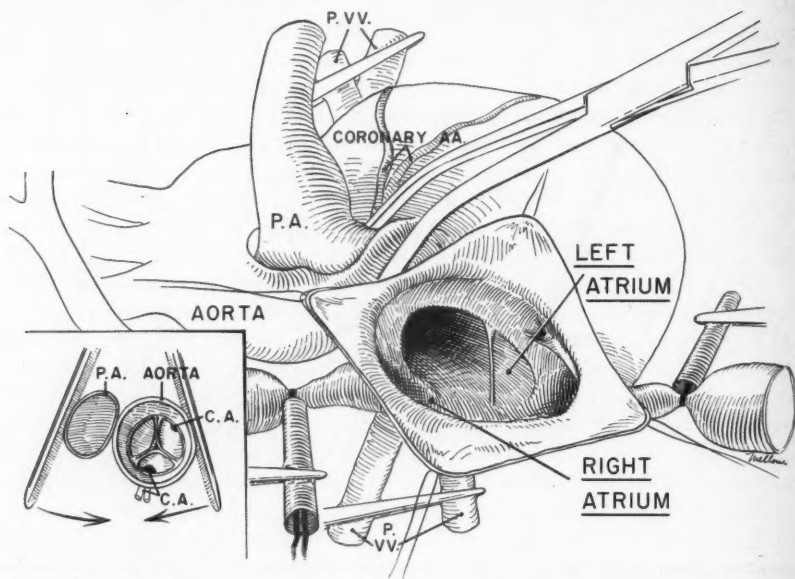


FIG. 7. The clamp has now been removed from its position distal to the aortic valves and placed instead across the aorta, the pulmonary artery and, for the express purpose of preventing coronary air embolism, across the coronary arteries as well. With the total outflow thus blocked off the right and left pulmonary veins are quickly clamped thereby achieving complete inflow-outflow occlusion.

In quick succession the atrial clamp is removed and what little blood is left in the heart is aspirated. The defect in the interatrial septum then can be easily visualized as can any associated anomaly. This particular defect measured 5 cm. in diameter. Although it presented an adequate rim anteriorly and superiorly, no rim existed posteriorly other than the atrial wall itself. The presence of a small strand of tissue running across the defect, such as shown here, is not unusual.

circulation for a few minutes and then reopen the heart rather than exceed this safe period. To date we have had to resort to no more than one period of circulatory arrest in any individual. Finally, we should point out that onlay grafts rarely are necessary in this type of septal closure, due largely, no doubt, to the contracted state of the occluded heart.

The defect closed, air is flooded out of the left atrium by spreading a hemostat in the suture line and pouring in saline. The margins of the atrial incision are elevated and as saline fills the entire heart, air no longer bubbles up from the left atrium. The hemostat is withdrawn and the noncrushing atrial clamp is reapplied. In quick succession the aorta, pulmonary artery and pulmonary veins are unclamped. The ligature around the superior vena cava now is loosened. After the heart fills and resumes a forceful beat, the remainder of the cardiac work load is returned by releasing the inferior vena cava. Closure of the heart and chest wall now can be completed at leisure.

The atrial incision is approximated by interrupted No. 000 figure-of-eight sutures, after which the noncrushing clamp can be removed. Both pleural spaces

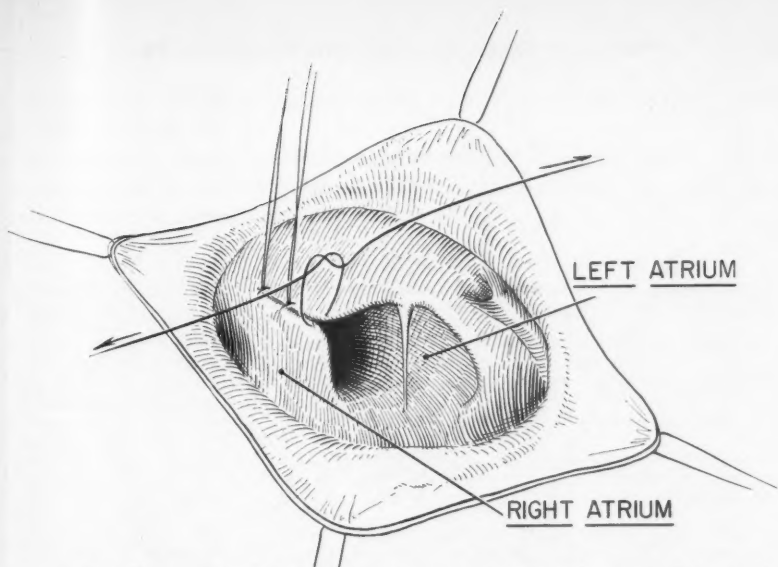


FIG. 8. This close-up view of the defect demonstrates the placement of interrupted sutures under direct vision. Eight minutes is the longest period during which complete inflow-outflow occlusion safely can be continued. Despite its size this defect was closed and the circulation restored within 7 minutes and 40 seconds. Occasionally the presence of one or more small openings in the wall of the right atrium will cause some concern as to whether there is an anomalous vein emptying into the atrium, or whether it represents the coronary sinus ostium. This can be readily solved simply by gentle release of the clamp on the right pulmonary veins.

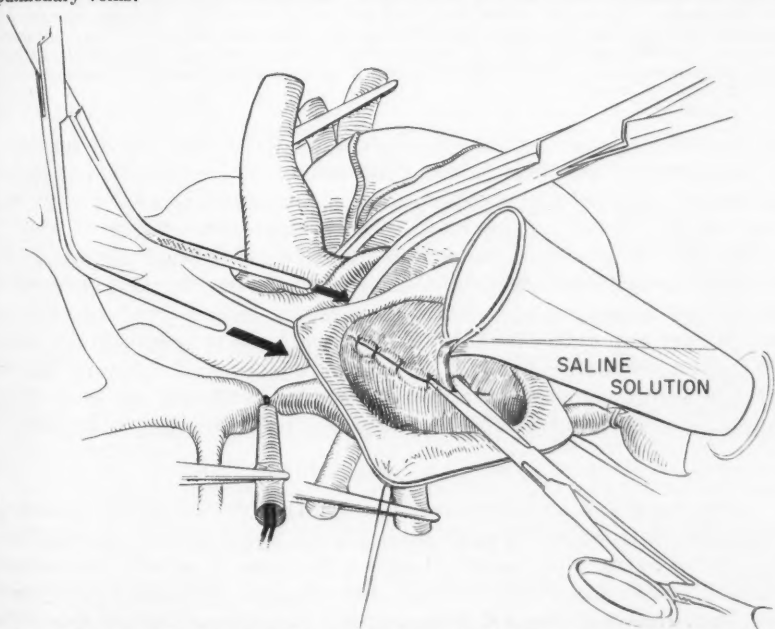


FIG. 9. The interatrial septal defect has now been closed with sutures. A hemostat placed between 2 of these sutures permits complete egress of air following flooding of the heart with saline. As saline fills the heart, the noncrushing atrial clamp is reapplied.

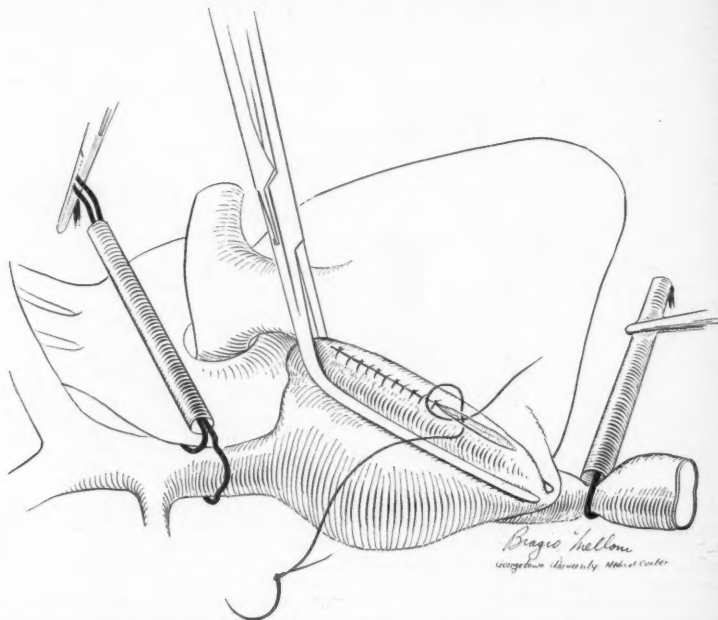


FIG. 10. Once the atrial clamp is back in place, the other clamps promptly are removed from the aorta, pulmonary artery, and both pulmonary veins. The ligature around the superior vena cava now is released and the heart fills once again. When the heart resumes its normal forceful beat, the inferior vena cava gradually is released. Cardiac massage and intracardiac medication may be utilized whenever necessary. At this point the cardiectomy may be closed at leisure.

are irrigated and bilateral water-sealed drainage is established. The rib spreaders are disengaged. After reapproximating the sternum with several heavy braided silk sutures, the chest wall is closed routinely. We apply aeroplast over the incision and around the drainage tube to secure a water-tight dressing.

*Warming.* The patient is immersed in a tub of water approximately 45 C. As the patient warms, attention still is directed to the electrocardiograph and a surgeon continues to stand by in the event of cardiac arrest or ventricular fibrillation. As body temperature rises, the heartbeat and blood pressure improve. When the temperature reaches 36 C. the patient can be transferred to a warm bed. In our experience a normal temperature is reestablished without any great delay, and we have not encountered rebound hyperpyrexia as described by Bigelow.<sup>7</sup>

#### SUMMARY

A great variety of procedures recently have been devised for the closure of interatrial septal defects. Most of these methods entail the inherent disadvantages of indirect or blind suturing technics. By means of general hypothermia sufficiently prolonged periods of cardiac inflow occlusion can be tolerated to permit open cardiectomy and closure of interatrial septal defects under direct vision. The

evolution of this procedure is described and the technical aspects of the operation are presented in detail.

The authors are deeply indebted to Dr. Bernard J. Walsh, Dr. John O. Nestor and Dr. Charles E. Fierst without whose help and cooperation this study could not have reached clinical application.

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## EDITORIAL

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### IS BIOPSY SAFE?

There is increasing evidence that operations which do not completely encompass cancer but cut across it may spread cancer and accelerate the course of the disease. This tendency for cancer to be implanted and disseminated by operation is seen even in such slowly growing cancers as papillary cancer of the thyroid—a tumor which if left alone shows little tendency to distant spread. If papillary carcinomas are cut into, they often grow back as implants in subcutaneous tissue or muscle. Often these invasive recurrences cannot be removed. The tendency to distant metastasis in these cases is significantly increased.

Even needle biopsy does not appear to be safe. A papillary carcinoma of the thyroid was diagnosed by needle biopsy and removed 2 days later. Two years later it recurred as a skin nodule at the site of the needle puncture. Four years after the biopsy, the patient died of systemic metastases.

A recent report on cancer of the thyroid in which routine needle biopsy was advocated, illustrates the danger of biopsy. Despite the most radical operations, 38 per cent of the patients with papillary carcinoma of the thyroid were either dead at the end of 5 years or had had unremovable recurrences. This rate of recurrence is between 4 and 5 times as high as that usually reported following much more conservative operations. Since treatment in these cases was by the most radical type of cancer operation, it is difficult to escape the conclusion that it was the needle biopsy that disseminated the tumor and rendered it incurable.

Biopsies of abdominal cancers such as cancers of the pancreas, metastatic cancer of the liver and localized cancers of the stomach should be undertaken with the greatest caution. Cells exfoliated from these tumors or squeezed out of them may implant themselves on peritoneal surfaces. It is this type of dissemination of cancer that gives credence to what our patients already think and tell us—that cutting into cancer spreads it and makes it grow.

Biopsy is useful in diagnosis. Employed carefully and in selected cases it may do no harm. If used indiscriminately, it may spread disease and shorten life. Even in patients with incurable cancer the surgeon has a grave responsibility. His operations, when they can do no good, at least should do no harm.

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## BOOK REVIEWS

The editors of *The American Surgeon* will at all times welcome new books in the field of Surgery and will acknowledge their receipt in these pages. The editors do not, however, agree to review all books that have been submitted without solicitation.

*Thoracic Surgery*. Second Edition. By RICHARD H. SWEET, M.D., Associate Clinical Professor of Surgery, Harvard University Medical School. Illustrations by Jorge Rodriguez Arroyo, M.D., Formerly Assistant in Surgical Therapeutics, University of Mexico Medical School. W. B. Saunders Company, Philadelphia and London, 1954. Price \$10.00.

The organization and subject matter in the second edition of *Thoracic Surgery* is well organized and ably presented. A review of surgical anatomy of the thorax is concise and complete. The more common vascular anomalies of the pulmonary vessels are presented. The illustrations are excellent, allowing the reader to obtain a clear pictorial orientation of anatomy and the surgical procedures entailed.

The section on general technical consideration incident to thoracotomy is basic. This book is especially strong on operative technic. The common operations on the thoracic wall, pleura, lung, mediastinum and esophagus are described.

This book is recommended for study and reference for those doing surgery of the thorax.

CREIGHTON A. HARDIN, M.D.

*Peripheral Vascular Diseases*. Second Edition. By EDAGE V. ALLEN, B.S., M.A., M.D., M.S. in Medicine, F.A.C.P., of the Section of Medicine, Mayo Foundation, Graduate School, University of Minnesota; Diplomate of the American Board of Internal Medicine; NELSON W. BARKER, B.A., M.D., M.S., in Medicine, F.A.C.P., of the Section of Medicine, Mayo Clinic, Professor of Medicine, Mayo Foundation, Graduate School, University of Minnesota, Diplomate of the American Board of Internal Medicine; and EDGAR A. HINES, Jr., B.A., M.A., M.S. in Medicine, F.A.C.P., Section of Medicine, Mayo Clinic, Professor of Medicine, Mayo Foundation, Graduate School, University of Minnesota; with Associates in the Mayo Clinic and Mayo Foundation. 317 Illustrations, 7 in color. W. B. Saunders Company, Philadelphia & London, 1955.

This book, which has been a standard reference and text on peripheral vascular diseases since its first publication in 1946, has now been revised with the addition of several new sections including recent developments in the surgical management of these conditions.

In addition to the three authors who are members of the Department of Medicine of the Mayo Clinic, thirteen additional staff members of the clinic contribute sections to the book.

The authors are careful to point out that the term "peripheral vascular disease," is a poor one and includes a wide variety of conditions having in common only the fact that they involve blood vessels. As in the previous editions, all diseases involving the veins, arteries, and lymphatics are included with the exception of arterial hypertension, and vascular disease of the central nervous system. The major diseases are covered in an extensive manner from historical background to treatment and prognosis. The sections on surgical management are fairly complete with details of the procedures described, even though the book is not primarily directed toward operative technique.

There is still much to be learned in this broad field, and the authors state their desire that this text will be the base for future research in the problems of vascular disease. Since many of these problems are a part of the aging process, the physician is being presented with such cases with increasing frequency as the life span is lengthened.

The organization, make up, and printing of this volume are excellent. The text is liberally supplemented by pictures, drawings and diagrams. Many of the chapters are introduced by

a picture and biographical sketch of one of the medical pioneers who contributed to the early development of the field.

Every physician should have ready access to this volume.

GEORGE A. HIGGINS, M.D.

*Christopher's Minor Surgery*, Seventh Edition. Edited by ALTON OCHSNER, M.D., F.A.C.S., William Henderson Professor of Surgery and Chairman of the Department of Surgery, Tulane University of Louisiana School of Medicine, and MICHAEL E. DEBAKEY, M.D., F.A.C.S., Professor of Surgery and Chairman of the Department of Surgery, Baylor University College of Medicine. W. B. Saunders Company, Philadelphia and London, 1955. Price \$9.00.

Since the first edition of *Christopher's Minor Surgery* appeared in 1929, this text has been a valued tool in the hands of several generations of physicians. The present edition, its seventh, is so radically different it is essentially a new book. It bears Christopher's name but, in keeping with the current trend, is a compilation of the work of many authors. The type and format are sharply changed. Both lead to increased ease of reading and facility of reference.

The current volume contains only about half as many pages as the last and probably less than half as many words. While some of this condensation has been achieved by deletion of obsolete material and by more concise and lucid exposition in certain areas, a significant part of it has resulted from limitation of the scope of the book. There has been a reduction in the rich store of how-to-do-it descriptions and diagrams of the little things of practice which loom so large in the experience of the interne and beginning practitioner. It was precisely the availability of this material which endeared previous editions to many of us. For example, the current volume does not contain Bunnell's excellent diagrams of where to cut and where not to cut in treating hand infections, or how to fit crutches to a patient, or how to fit a halter for head traction, or how to use Michel clips, or how to pack a nose for hemorrhage. By no means all such material has been deleted and most of that which remains has been reillustrated to advantage.

The sections on anesthesia, burns, and diseases of the veins and lymphatics appeal to this reviewer as especially well done. The material on injuries and infections of the extremities, now called Musculoskeletal System, has been most severely curtailed. It is to be regretted that the editors and publisher felt compelled to limit the size of the volume and thus to reduce its scope. The material which is contained, is well written, well organized and current, and will be most useful to internes and general practitioners as well as to the surgical residents for whom it has been prepared.

HUGH A. FRANK, M.D.

*Manual of Hand Injuries*. By H. MINOR NICHOLS, M.D., Clinical Instructor in Surgery, University of Oregon Medical School, Portland. Foreword by Michael L. Mason, M.D. The Year Book Publisher, Inc., 200 East Illinois Street, Chicago. Price \$9.50.

This small book, a manual on injuries of the hand, covers in its 352 pages, which includes the bibliography, the various aspects of injuries and other problems of the hand in a concise and clear manner. This book will be very useful, not only to general practitioners, those in charge of emergency room services, industrial surgeons, and other surgeons of trauma, but, also, to general surgeons, and surgeons of the hand, as a quick reference. The anatomy of the hand is adequately but briefly covered. Technical aspects of block anesthesia, surgical technic, and the use of splints, are presented in a helpful way. Simple problems in regard to amputation and coverage problems of the digits are very well covered. Burns and the coverage problem they impose are well discussed both from the standpoint of early emergency treatment and the later problems of coverage. The severe compound injuries that involve bone, tendon, nerve, joints, and large vessels, are well discussed from the standpoint of

general management and many of the difficult problems of judgement are discussed and well illustrated by well chosen photographs.

Most of the common fractures of the hand are illustrated radiographically, as regards diagnosis and treatment. Common infections are well illustrated as well as practical plans for their treatment. Large reconstructive problems, especially tendon grafts and transfers, with special notes on difficult small problems are brought out in such a way that this manual is recommended, without reservation, not only for the house staff's usage but for a ready reference for any who engage in surgery for the hand.

DAVID W. ROBINSON, M.D.

*Abdominal Operations.* Third Edition. RODNEY MAINGOT, F.R.C.S., Eng; Surgeon to the Royal Free Hospital, London, and to the Southend General Hospital. Appleton-Century-Crofts, Inc., 1955; New York. Price: \$24.50.

In the new third edition of this well known work, Mr. Maingot has added new chapters and deleted several for a total of 74. There are 1580 pages.

The work deals with the technic of various abdominal operations, with consideration of the choice of procedure, difficulties and dangers, pre-operative and post-operative management, complications, and immediate and remote results. In all, a comprehensive exposition is made of the procedures presented.

The volume is profusely illustrated with half-tone and line drawings and photographs. Their quality is excellent in nearly every instance.

Mr. Maingot's style of writing and choice of words makes for a very clear, readable and scholarly presentation.

Some of the procedures described apparently are more popular in England than here, but this does not detract from the volume. The bibliographic data parenthetically placed after an author reference is not a common practice in this country and the lack of a list of references may prove inconvenient for those doing literature research. Also, it is a bit unusual to encounter occasional case histories in such a work.

However, these points of variance do not seriously detract from the quality of material presented, and it is thought that this book may be recommended for inclusion in any surgeon's library.

T. G. ORR, JR., M.D.

## BOOKS RECEIVED

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*Books received are acknowledged in this section, and such acknowledgement must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.*

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*Medical Progress: A Review of Medical Advances During 1954.* By MORRIS FISHBEIN, M.D., Editor. The Blakiston Division, McGraw-Hill Book Company, Inc., New York, Toronto, London, 1955.

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